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Heating · Piping and Air Conditioning

Installation
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TOBER, 1937

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—Journal Section of
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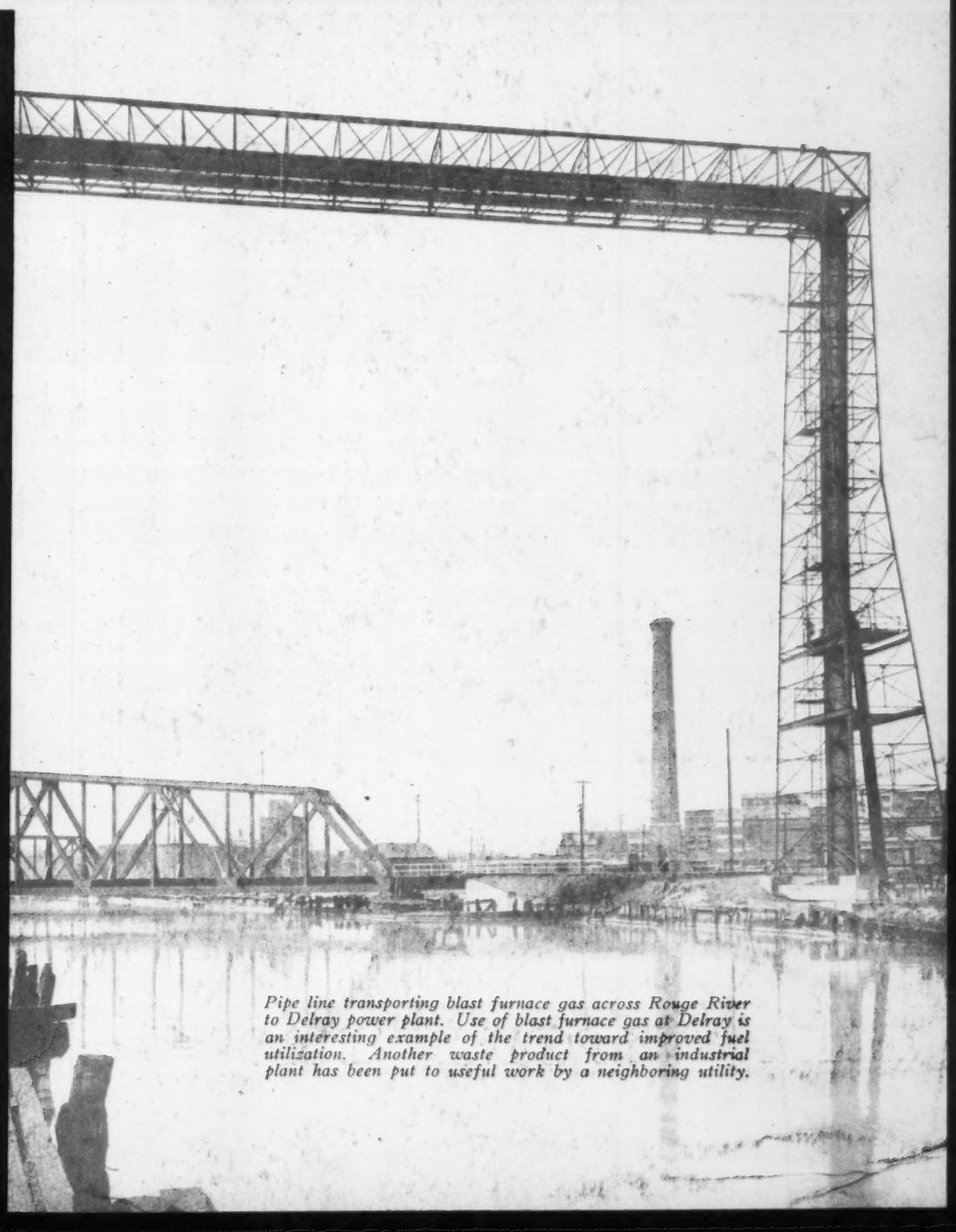
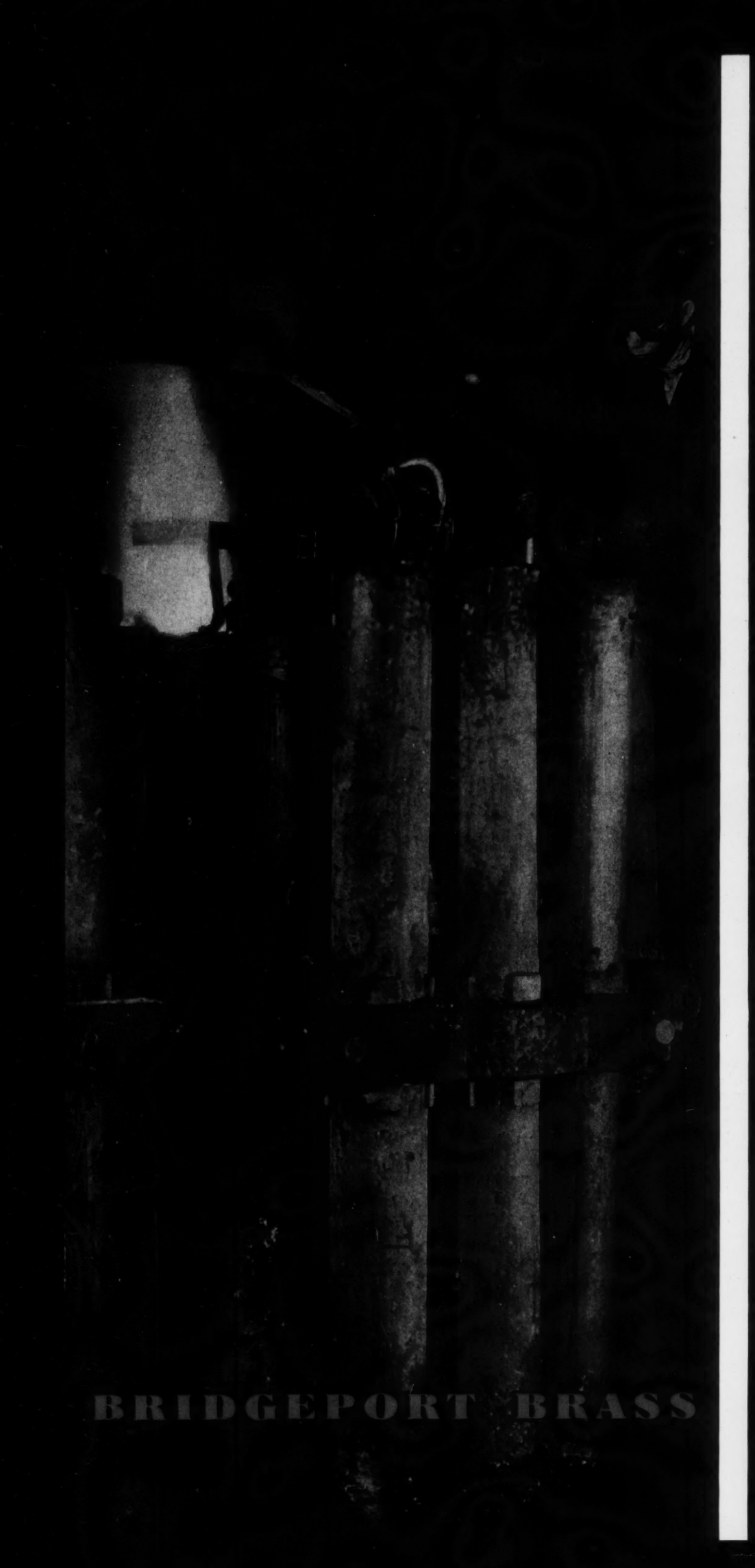


Pipe line transporting blast furnace gas across Rouge River to Delray power plant. Use of blast furnace gas at Delray is an interesting example of the trend toward improved fuel utilization. Another waste product from an industrial plant has been put to useful work by a neighboring utility.



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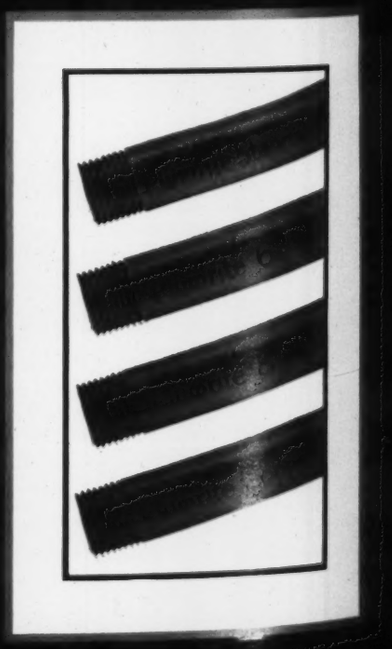

BRASS "Bridgeport" COPPER

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The Editor's Page

■ **Summer layoffs** caused by excessive heat and humidity in the lower depths of the Magma copper mine in Arizona were avoided for the first time in the mine's history this summer with air conditioning which cut temperatures seven degrees 48 hours after the equipment started operation. . . . Formerly it was the custom to shut down every year during July or August for four weeks because of the excessive heat and severe working conditions. . . . The air conditioning installation was supervised by Willis H. Carrier. . . . A **winter** sales volume during **summer** months is approximated because of air conditioning of Kugler's restaurant in Philadelphia, according to W. B. Kugler in an interview published in "Air Conditioning News," issued by the Philadelphia Electric Co. Formerly Kugler's anticipated the fall season opening about October 1, but now they find it is practically in full swing the first of September, which is believed to be due to holding a heavy volume of patrons right through the summer. . . . The Bowling Foundation, Inc., sponsored by the Brunswick-Balke-Collender Co., is planning to operate several bowling alleys in different cities—some conditioned, and some not—to study the effect of air conditioning on summer bowling.

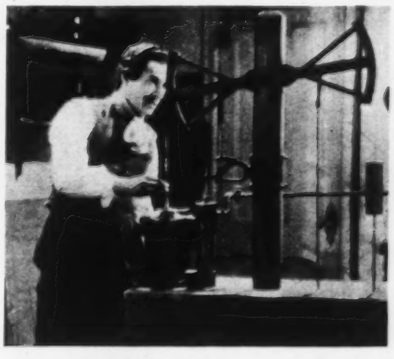
■ **Announcement of another** possible solution of the silicosis problem has been made in a medical report by scientists and physicians at the University of Toronto, who suggest that tiny traces of aluminum dust added to the silica-filled air breathed by workers may eventually stay the ravages of silicosis, according to the "Industrial Bulletin" issued by Arthur D. Little, Inc. These investigators were able to prevent silicosis in the case of rabbits that breathed silica-filled air containing a trace of aluminum powder, while rabbits that breathed the silica dust alone contracted silicosis. From this work, it has been concluded that the presence of the aluminum in the dangerous dust inhibits the rapid solution and concentration of the silicious material, thereby preventing degeneration of the lung cells and the production of fibrous tissue. . . . Silicosis is known by a wide variety of names, such as "miner's consumption," "potter's asthma," or "grinder's rot," according to the occupation in which it is caused, but in all cases it is a disease due to the inhalation of silica dust. It is characterized anatomically by generalized fibrotic changes, and clinically by the shortness of breath, decreased chest expansion, lessened capacity for work, increased susceptibility to tuberculosis, and by characteristic x-ray findings. While possibly not the worst American health hazard, silicosis will continue to be dangerous as long as there are unprotected workers in dusty occupations, says the "Industrial Bulletin."

■ **The first official** showing of the sound motion picture, "Heat and Its Control," was given last month in New York City. Produced by Johns-Manville, this film visualizes the story of heat from the time man worshipped the sun to present day methods of development and manufacture of heat conservation materials. More than 500 scenes are incorporated, many of them depicting milestones in the story of man's attainment of mastery over heat, such as Watt's invention of the first practical steam engine.

■ **Among the thirteen** new technologies which seem to be heading for a boom—and which the subcommittee on technology of the National Resources Committee believes should be watched by a board established to keep tab on developments—are air conditioning and prefabricated houses. The others are synthetic rubber, automobile trailers, plastics, artificial cotton and woolen-like fibers from cellulose, the mechanical cotton picker, television, gasoline produced from coal, facsimile transmission, steep flight airplanes, tray agriculture, and photo-electric cells.

■ **First issue** of "Arc Welding Foundation News," published by The James F. Lincoln Arc Welding Foundation, appears this month and gives further information on the $200,000 award program recently announced by the Foundation. . . . Created late last year, the express purpose of the Foundation is to stimulate scientific progress of the arc welding industry. The award program, offering $200,000 for studies of arc welding applied to the products and works of industry, is the first of the activities of the Foundation in its plan to encourage arc welding progress. A. F. Davis, secretary of the Foundation, recently issued a memorandum for those interested in the Foundation's work amplifying the purpose of the award program. . . . According to the electric welding section of the National Electrical Manufacturers Association, the growth in volume of the electric arc welding process is clearly shown by their figures on electric welding wire consumption which grew from 18.8 millions of pounds in 1932 to 111 millions of pounds in 1936.

James Watt bound strips of wood around the boiler of his steam engine in an attempt to conserve heat to do useful work. This was the first recorded use of insulation for this purpose. (From "Heat and Its Control.")



■ **Signed with a glass pen,** on a glass top desk, in a glass room of a glass office, the contract for participation of the glass industry in the New York World's Fair, 1939, provides for some 57,000 sq ft of space in the heart of the exhibition area. A company known as Glass, Inc., has been formed by Owens-Illinois Glass Co., Corning Glass Works, and Pittsburgh Plate Glass Co. to carry out the project. . . . American Radiator and Standard Sanitary Corp. has signed a contract with the Fair for an acre and a half of ground on which to erect a building, according to an announcement by Grover Whalen, President of the Fair Corp. It is to contain exhibits of fourteen affiliated companies.

"The July issue of HEATING, PIPING AND AIR CONDITIONING has just come in and it looks fine. You are certainly doing a splendid job in publishing and editing H. P. & A. C., and it is a magazine that is 'tops' in the industry."—An Atlanta consulting engineer.

"From a general run through the magazine it would be my reaction that the August issue is one of the finest that you have published. Keep up the good work."—Chief engineer of an air conditioning contracting organization in Detroit.

"The September number of H. P. & A. C. is a great magazine of information, splendidly gotten up."—A heating company in New Jersey.

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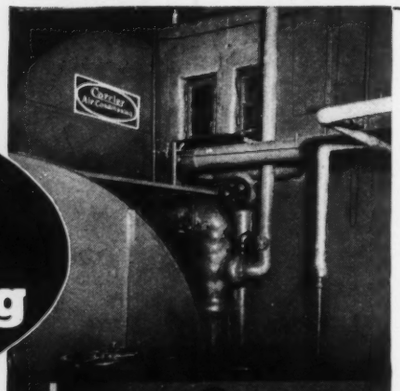

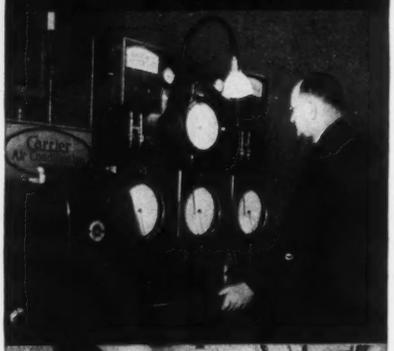

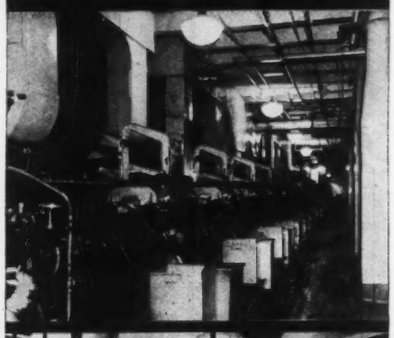

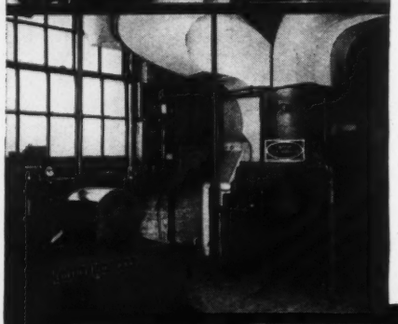

1. OLD TIMER is this Carrier Dehumidifier, but it's on the job every day of the year, washing and cleaning the air, controlling the temperature and humidity.

2. VARIATIONS? Not much! The recording gauges prove the Carrier equipment as accurate today as it was years ago, when first installed.

3. CAPSULES are filled in this room so fast it makes your head swim. The reason? Year 'round humidity control — which protects the capsules against breakage, guards the quality of their contents.

4. UPSTAIRS another Carrier Air Conditioning System — installed only a few months ago — carries on the good work, but in a different manner.

5. SERUMS are bottled in separate glass-enclosed rooms, like the one below, at a temperature always the same. It's made possible by the Carrier installation. See the outlet behind the light?

6. ANOTHER JOB . . . Packing the tiny glass vials — requires constant temperature. So here again you find Carrier on the job, living up to the Carrier reputation for accurate temperature and humidity control.

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CONTENTS *for* OCTOBER, 1937

Volume 9 Number 10

Air Conditioning Influences Building Design, by J. H. Walker 599

Retail Store Air Conditioning Surveyed 602

New Data for Refrigeration Piping Design (Methyl Chloride Liquid Line Piping), by R. C. Doremus 603

Hospital Air Conditioning Requirements Outlined 607

New Type of Unit Furnishes Heat and Power to Ford's Valve Plant 608

E. Vernon Hill's Personal Comments (Saturated Air) 610

Selecting the Right Size Heating Boiler, by Sabin Crocker (H. P. & A. C. Summary Sheets) 611

Recent Changes in National Piping Standards, by Sabin Crocker and Harvey A. Wagner 613

Heating Fuel Consumption Data, by Kalman Steiner 618

Rational Psychromatics, by E. Vernon Hill 621

Solving Piping Flow Problems, by William Goodman 625

Applying Air Conditioning to an Existing Building, by M. Kennedy 630

Practical Standards for Air Conditioning Calculations (The Survey and General Procedure), by W. S. Bodinus 632

Booklets, Reports and Papers 658

Book Reviews (back section) 116

Schools and Study Courses (back section) 117

Conventions and Expositions (back section) 117

Equipment Developments (back section) 118

Recent Trade Literature (back section) 138

Index to Advertisers (back section) 146

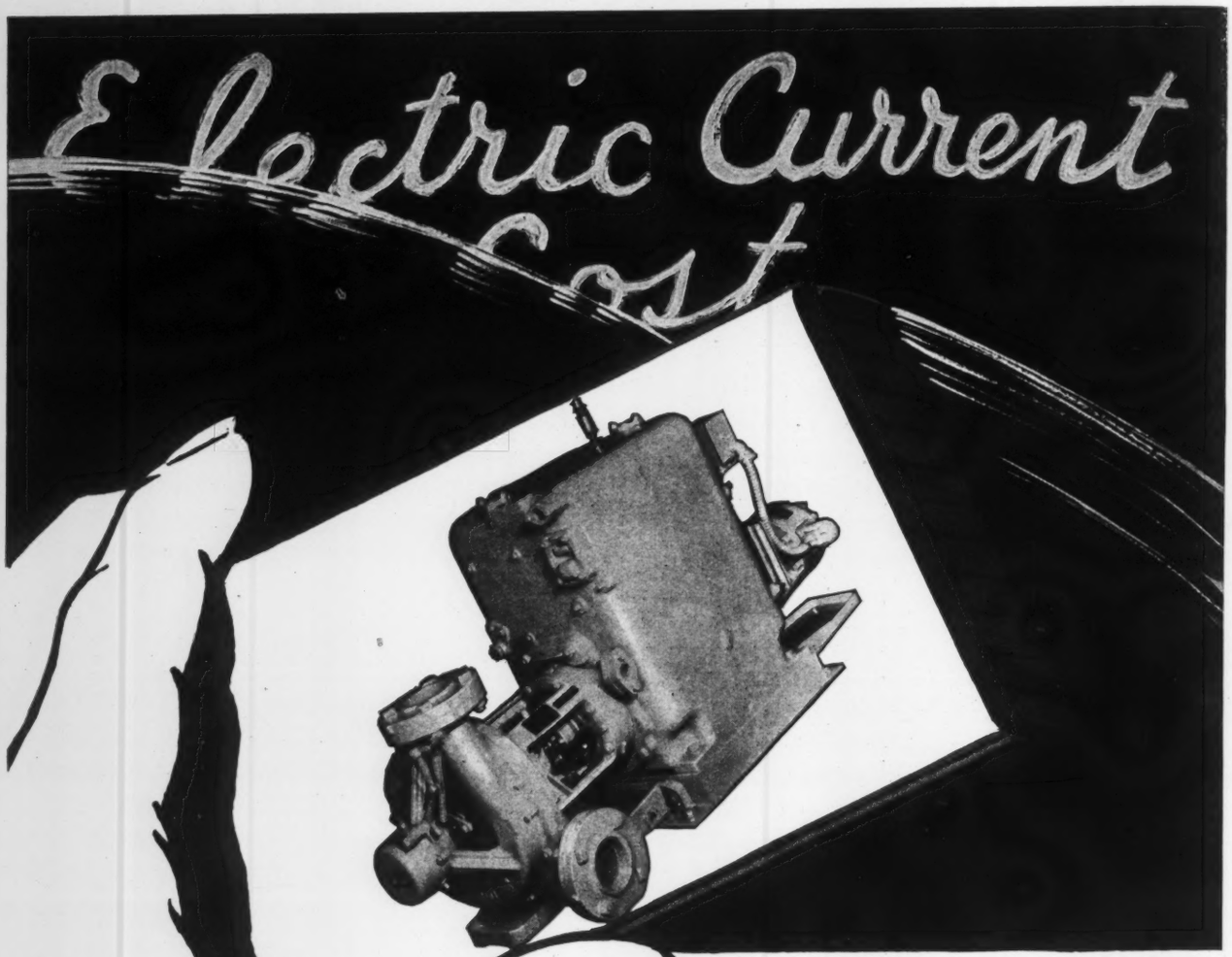
Journal Section of the American Society of Heating and Ventilating Engineers

Application of Air Conditioning to the Treatment of Disease, by C. P. Yaglou 635

Proper Air Conditions for the Manufacturing of Confections, by A. E. Stacey, Jr. 640

Heating, Ventilating and Air Conditioning Courses 643

Bulletin Section 646



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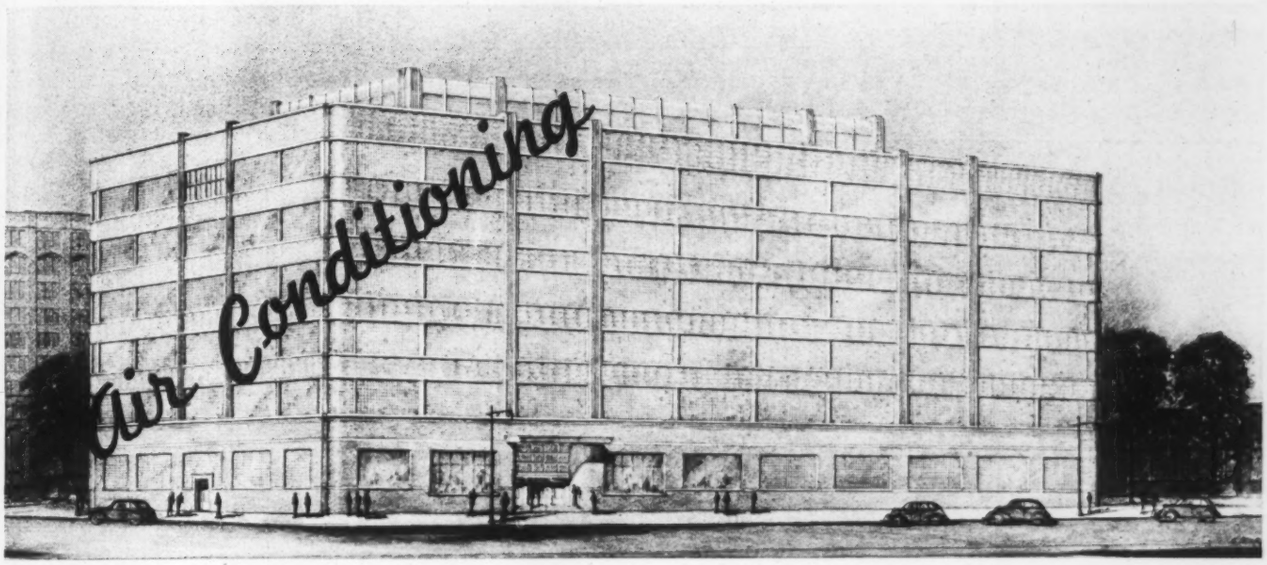
Vol. 9, No. 10 ● *October, 1937*



Influences Building Design

Advantage Taken of Its Possibilities in New Detroit Edison Company Building

By J. H. Walker*

THIS article describes a building now being erected by The Detroit Edison Company in which certain new structural materials, air conditioning, and improved lighting have been utilized and full advantage taken of their possibilities. Careful coordination of several of these features has made the building reasonably low in cost and it should be comfortable and efficient in use.

Because relatively few large buildings have been constructed since air conditioning has become an accepted feature, there has been little opportunity to evolve building designs in which it is a basic element. The influence which air conditioning can exert is important both architecturally and economically.

In the past the design of office buildings has followed the principle that every square foot of floor space should be but a short distance from a window, because the window was regarded as the essential source of light and ventilation. Consequently office buildings have been composed of narrow wings, with floor plans resembling the letters U, H, or E. But with air conditioning and adequate artificial lighting, proximity to a window is no longer a requirement and an office building may take the simple and economical form of a parallelepiped.

The use of glass brick in the exterior walls of an office building also has definite advantages. This new structural material produces what is literally a translucent wall, admitting large amounts of daylight. Its wintertime heat loss is reasonably low, air infiltration is negligible, and its heat gain in summer is much less than that of unshaded windows.

A Building for a Special Purpose

This building will be used by several office and shop departments which are important units in the Company's service. Typical of these are an electric appliance repair division which services 7000 customers' appliances per month, a meter testing and repair department which handles 7000 meters per month, and a mechanized customers' accounts division whose monthly quota is 300,000 bills. The building is planned for a variety of activities such as these and for clerical and engineering offices. A serious effort has been made to design the building for working efficiency and for the comfort of the employees.

*Engineer Assistant to the General Manager, The Detroit Edison Company.

Because few large buildings have been constructed since air conditioning has become an accepted feature, there has been little opportunity to evolve building designs in which it is a basic element—although the influence which air conditioning can exert is important both architecturally and economically. . . . The Detroit Edison Company's new service building is a definite illustration of this influence of air conditioning on building design, and is an example of an attempt to correlate air conditioning, lighting, and architecture to produce a building appropriate for its intended use and reasonably low in first cost

The ground area covered is 248 by 120 ft and the building is six stories in height. The location is on the outskirts of the downtown business district, near the Company's general office building. Fig. 1 shows its exterior.

Complete air conditioning was considered as one of the fundamental requirements out of regard for the efficiency and comfort of the employees. The low productiveness and extreme discomfort during the summer of those engaged in exacting work has long been an undesirable condition in the present quarters.

Glass Brick for Exterior Walls

The use of glass brick in the exterior walls with the almost total absence of windows is due largely to the winter-time discomfort directly chargeable to ordinary windows. Window chill and leakage have always been an annoyance and the use of radiators under the windows in other company buildings has not been a satisfactory answer because of the discomfort of nearby occupants from the concentrated heat from them. On the other hand, a previous attempt to eliminate radiators and use a fan system for heating did not prove wholly satisfactory without double windows.

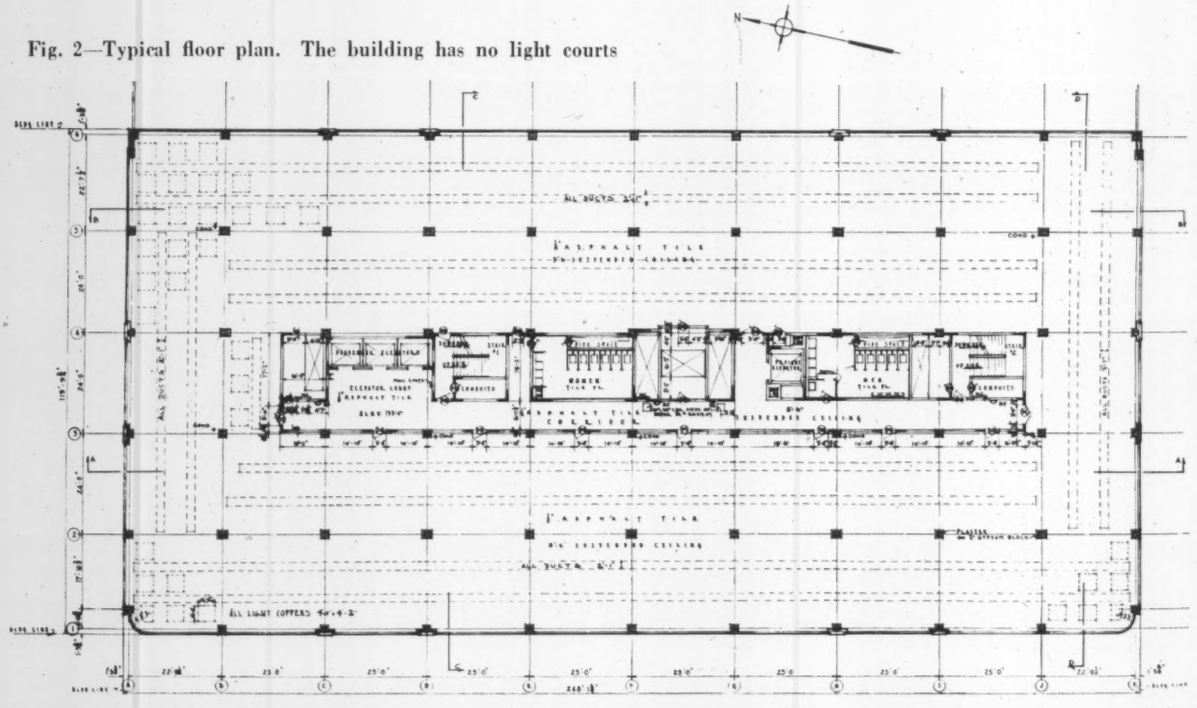
Therefore, double windows or their equivalent were set up as a basic requirement. When double windows were compared with glass brick it appeared that the latter were not appreciably more expensive and had certain advantages such as less frequent and simpler cleaning requirements, freedom from the painting and maintenance of sash, etc.

The winter heat loss through glass brick appears to be about equal to that through double sash and the infiltration should be negligible. The summer heat gain for glass brick exposed to the sun is stated (by the manufacturer) to be something like 54 per cent of the heat gain through an equal area of unshaded factory type sash. In this case the area of glass brick is perhaps 30 per cent greater than that of the windows which might have been installed. The glass brick, however, will not be shaded by awnings, whereas the windows would have been. The net result is that the cooling load on the sunny sides of this building is appreciably increased by the use of glass brick. Incidentally, much remains to be learned about the thermal properties of glass brick, as available information regarding its heat loss and heat gain is not as complete or well established as is desirable.

The light transmission characteristics of glass brick are quite different from those of windows. The glass brick, with its refractive pattern, picks up the external light from all directions and its inside surface brightness is the average of all of the light striking it—whether from the sun, the sky, or the surrounding buildings. The lower part of the glass brick wall may therefore appear far brighter to the eye than the view through a transparent window. Whether or not louver blinds or other glare-dimming devices must be used is an open question.

Some people object to the idea of a building without windows on the score that the psychological effect of being unable to see out-of-doors would be distressing. If this were generally true one would expect to have heard more strenuous objections from the thousands who work in department store basements, banks, etc. This un-

Fig. 2—Typical floor plan. The building has no light courts



founded fear may be due to someone having coined the term "claustrophobia" to describe the fear of being confined. It is not expected to be experienced in this building by the psychologically normal.

No Light Courts

The plan of a typical floor is shown in Fig. 2. Air conditioning and plenty of artificial light make possible the elimination of light courts, which greatly reduces the cost of the building. Had this building been designed in accordance with former practice the floor plan would probably have been given the shape of the letter E. The gross floor area would then have been 24 per cent less and the perimeter would have been 38 per cent greater. Instead of the present ratio of 40 sq ft of gross floor area to one foot of perimeter the ratio would have been 22 to one. The effect of omitting light courts on the cost of the building per square foot of floor area is evidently very great indeed; also, the ground area is fully utilized and the floor space can be much more efficiently arranged.

These collateral advantages of air conditioning have probably not yet become fully appreciated. The saving in building cost is an important contribution toward the cost of the air conditioning system.

Lighting Coordinated With Air Conditioning

Since many of the activities to be housed in the building involve much visual effort a high standard of artificial illumination is required in many areas. The specifications were shadowless and glareless light with a minimum level of 35 foot-candles—and that means after some deterioration of ceilings and lamps. The method of lighting finally chosen not only met these requirements but made possible an interesting structural coordination with the air conditioning system.

The depth of the office space from outside wall to corridor—that is, the section illustrated in Fig. 3—is approximately 50 ft. It did not appear practicable to attempt to distribute air from a corridor duct across this wide space; ceiling ducts seemed essential. Ordinary indirect lighting with suspended fixtures would have required an unobstructed ceiling and a minimum ceiling height of 10 ft, 6 in. for these conditions. If the air ducts were placed above such a ceiling the floor-to-floor height, after allowing for beams and girders, would have been expensively great.

An appreciable reduction of this dimension and consequently of overall building height and cost was accomplished by using a coffer lighting system, and a net floor to ceiling height of 9 ft, 6 in. There are nine coffers per bay, each being 4 ft square and 16 in. deep and containing a 300 watt incandescent lamp with a silvered bowl. The total wattage is 2700 per bay of 600 sq ft of 4½ watts per square foot. The lighting effect, as observed in a test room which has been built, is excellent and the desired illumination level is obtained with about two-thirds of the wattage required by ordinary indirect fixtures.

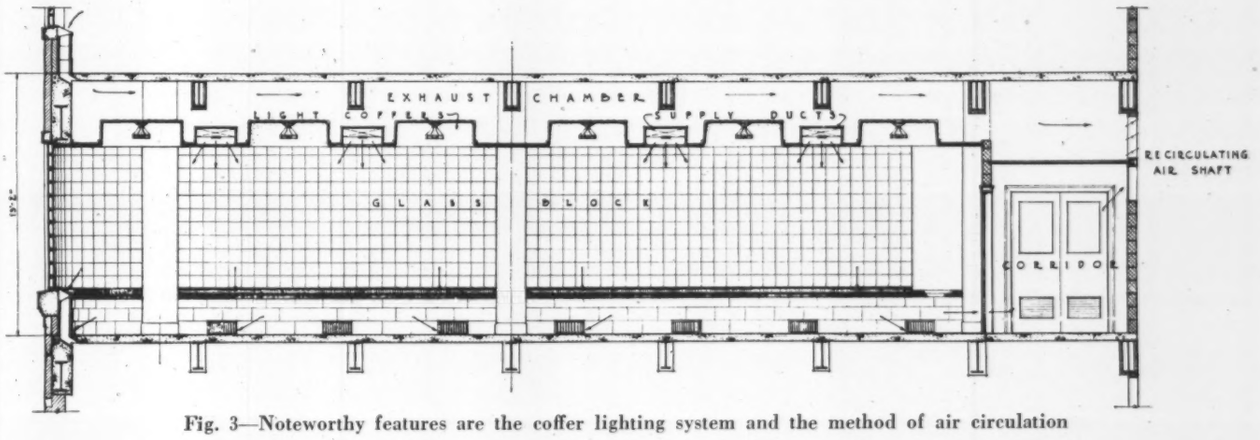


Fig. 3—Noteworthy features are the coffer lighting system and the method of air circulation

The Air Conditioning System

In a windowless building there are no intermediate seasons in spring and fall when the air conditioning system can be shut down. The heating and cooling seasons merge and overlap and in this building cooling will be required in some rooms well into the winter. Therefore, it seemed desirable as well as economical to combine the heating and cooling functions in one system. The absence of windows eliminated the need of radiators at the outside walls and it appeared entirely practicable to perform both functions with a central fan system. The general method is to circulate a constant volume of air and to vary its temperature by thermostatic control so as to maintain the desired room temperature. This is accomplished by using two sources of air, one above and one below room temperature, and automatically proportioning the quantities to give the required room temperature.

In a windowless building, if anywhere, the temperature control must be good. The occupants are quite at its mercy because there are no windows which can be

Table 1—Calculated Refrigeration Load

Heat Source	Tons of Refrigeration	Per cent of Total
Heat entering building structure	126.8	27.3
Heat from lights	119.6	25.7
Heat removed from outside air (sensible plus latent)	131.1	28.2
Heat from occupants (sensible plus latent)	60.9	13.1
Heating from fan power	26.5	5.7
Total	464.9	100.0

thrown open. Particular care has been given, therefore, to the control equipment and proper zoning from a cooling standpoint has been provided.

The itemized cooling and dehumidifying loads as calculated are given in Table 1. This shows the total maximum simultaneous load on the refrigerating plant. There is, of course, a considerable diversity between the loads in different areas. Although the loads were carefully calculated from every viewpoint the refrigeration tonnage finally chosen depended largely on the one vital assumption as to how much of the installed lighting wattage, totaling 981 kw, would be in use at the time of maximum load. It was finally assumed that at such times the lighting in all of the inner bays, constituting about 40 per cent of the total, would be in use, but that none need be in use in the outer bays since the maximum load is expected to occur on bright sunny days. The point is that while careful calculation of the load was important the final figure depended somewhat on an arbitrary assumption.

The air is introduced, as indicated in Fig. 3, through sections of the ceiling at a very low velocity. The ceiling is covered with an acoustic material beneath which are perforated steel plates, and through certain areas of these plates the air supply enters the room. In an extended series of tests on a full scale model this method appeared superior to any method of horizontal injection that was studied, as it seemed improbable that any method involving horizontal air movement at high velocity could successfully distribute air without drafts in this building; at least no such scheme could be devised during the experiments.

The air is withdrawn from the inner row of bays either to the corridor or directly to the vertical return shafts. From the outside bays it is withdrawn principally through a slot at the sill of the glass brick panel with a secondary withdrawal near the floor to prevent the pocketing of cool air. The sill exhaust is expected to absorb whatever down draft is created by the glass brick in winter.

The ceiling space is an exhaust chamber into which the air from the outside wall of the floor above finds its way. This space communicates with the return shafts via a duct in the corridor ceiling.

The backing tile in the exterior walls and much of the permanent inside partitioning of this building will be constructed of a building block developed by The Detroit Edison Company. It is made from the ash separated from the flue gases of pulverized fuel fired boilers, combined with lime and a little rosin, and makes a serviceable, well finished structural unit, resembling concrete block.

This building is a definite illustration of the influence which air conditioning can exert on building design through eliminating the need of window ventilation. It is also an example of an attempt to correlate the various elements such as air conditioning, lighting, and architecture in the effort to produce a building which will be appropriate for its intended use and reasonably low in cost.

Retail Store Air Conditioning Surveyed

THE current issue of *Air Conditioning Trends*[1] is devoted to a general analysis of commercial comfort air conditioning in the retail dry goods field, including chain stores, and points out trends or tendencies which will help to guide air conditioning sales executives.

The lead article, based on an interview with Channing E. Sweitzer, managing director of the *National Retail Dry Goods Association,* explains how air conditioning is aiding in the solution of store problems, and it is pointed out that with retail dry goods stores leading in the upsurge of air conditioning sales which began last year, this market offers new opportunities to the air conditioning industry, comparable to—if not exceeding—the potentialities in theaters. Mr. Sweitzer discusses the problems of the store executive in deciding upon air conditioning, and stresses that air conditioning of stores in 1938 will have to more than pay its way for, more than ever, air conditioning will be measured in terms of its sales productiveness, and will be bought on the basis of provable sales results. Because of a number of factors, normal sales increases no longer result in normal profits, and, therefore, a service such as air conditioning must produce more than a normal increase to warrant consideration.

An appropriate supplementary story, quoting John Guernsey, retail economist, suggests a factual basis for approaching the department store sales problem, stresses that air conditioning can be sold to retailers on the basis of provable savings, and then gets down to cases by taking the sales analysis of a typical department store and showing how air conditioning can increase the profit figure by increasing sales volume, decreasing returns, and saving on mark-downs. In the example analyzed it is demonstrated that a store's profit could be increased from 0.8 to 4.4 per cent by air conditioning. It is Mr. Guernsey's impression that there is not enough "factual selling" of air conditioning, and that instead of glossing over or running away from actual figures, these can be used to great advantage.

Another story gives a rough estimate of the retail field as a market for air conditioning, and *Trends* estimates that between 1000 and 2000 stores could be air conditioned from now until the end of next year if the present rate of air conditioning sales is maintained.

An article on air conditioning sales to chains is presented and it is stated that these will slightly more than double in 1937 over 1936. A growing trend is noted toward the extension of air conditioning to chains in the smaller cities. Among those chains leading in the number of stores conditioned are: Florsheim shoes, Walgreen drugs, Kresge, Woolworth, Thom McAn shoes, Lerner dress shops, and Howard clothes; some of these are approaching 100 per cent use of air conditioning in their properties.

Various other data of pertinent interest are also contained in this bulletin, including an abstract of an address on the effect of the air conditioning industry on distribution, by L. R. Boulware.

[1]Published by Keeney Publishing Co., 6 N. Michigan Ave, Chicago, Ill.

New Data for Refrigeration

Piping Design

Methyl Chloride Liquid Line Piping

By R. C. Doremus*

DATA on the piping of liquid and vapor of the refrigerant "Freon-12" have been given in earlier issues.[1] It is the purpose this month to present similar data on methyl chloride, CH_3Cl, which should assist the designer of refrigerating plants in the proper planning of the piping.

Whenever the piping of a refrigerant is up for consideration in any plant installation, it is necessary to plan a certain amount of piping, whether plain or finned, to serve as heat transfer surface in order to transmit the heat from one side of the pipe to the other according to the purpose of the equipment, such as condensers, evaporators and heat exchangers. Other piping must be installed as connections between the items of equipment to form a closed piping system and conduct the liquid and vapor refrigerant throughout this system in its cycle. This piping serves as conduit for the liquid or gaseous fluids instead of as so much surface and obviously must be installed of suitable sizes to match the capacity of the plant equipment.

No doubt the designing engineer has computed the physical characteristics of his problem and knows the magnitude of the load in tons of refrigeration, the desired temperature of the materials to be cooled and consequently the preferred refrigerant temperature and corresponding suction pressure to produce the results. He also knows the temperature of condensing water available and the consequent discharge pressure for the compressor. He has probably chosen the proper sizes of the major items of equipment, such as the compressor, discharge oil separator, condenser, liquid receiver, evaporators, suction accumulators, purge drum, purifier, etc., so as to balance the capacity of each item against the load effectively and efficiently. This choice is not a difficult problem inasmuch as capacity data and operation characteristics are easily obtainable from the equipment manufacturers.

Piping Must Be Right

However, the *more important problem of piping connections* between items of equipment is not usually determined by an equipment manufacturer, for the complete system may be composed of items from several manufacturers and none knows the field problems and arrangement of this equipment as does the designing engineer who is the contact man in close touch with the job at hand. If this designer chooses piping connections by snap judgment, some rule of thumb, hasty guesswork or just plain "horse sense" approximation, he may accidentally choose well. But he is more apt to be wrong than right, which may penalize the equipment and the manufacturer of it. If he uses engineering data as a basis of his choice, he is more likely to be right than wrong and this procedure will give the equipment more than an "even break" to perform to its proper and contemplated capacity.

So far as available equipment is concerned, the manufacturer of compressors, condensers, evaporators and other auxiliary equipment must furnish these items so that they are universally adaptable to operate under various conditions of suction pressures for evaporation temperatures from 40 F below zero to 40 F above. The methyl chloride liquid that must be handled at minus 40 F is 1.48 lb per min per ton and at plus 40 F is 1.28 lb per min per ton. The amount of methyl chloride vapor to be handled in suction lines at minus 40 F is 32,200 cu in. per min per ton while at plus 40 F, it is but 4920 cu in., or a variation ratio of better than six to one. This emphasizes the need for engineering design of piping connections, for no pipe sizes could be stipulated by the manufacturer that would give suitable velocities over this range of temperature applications. This also indicates the reason a compressor will handle more tons of refrigeration capacity at relatively high back pressures than at low pressures.

Methyl chloride is one of the newer so-called "low pressure" refrigerants in the same category as "Freon-12" and very close to it in pressures for the same temperatures. Both are quite a little lower than ammonia as will be seen from the curves in Fig. 1.

Piping Materials

Methyl chloride has no chemical effect on such metals as iron, steel, brass, bronze or copper but does attack aluminum. Obviously, the choice will often be brass, bronze or copper in preference to iron or steel on account of lower initial cost and this, together with lighter compressor construction permitted by comparatively low pressures, often enables methyl chloride installations to be made at a lower price than ammonia or carbon dioxide.

Copper is used for piping connections in most cases. In the smaller installations, soft copper tubing with flared brass fittings are common. In the larger commercial jobs, copper pipe with streamline fittings are generally used with 50/50 solder, although the code in some cities calls for forged brass fittings rather than cast and 95 per cent solder which requires 1050 F soldering temperature and more care in making the joints.

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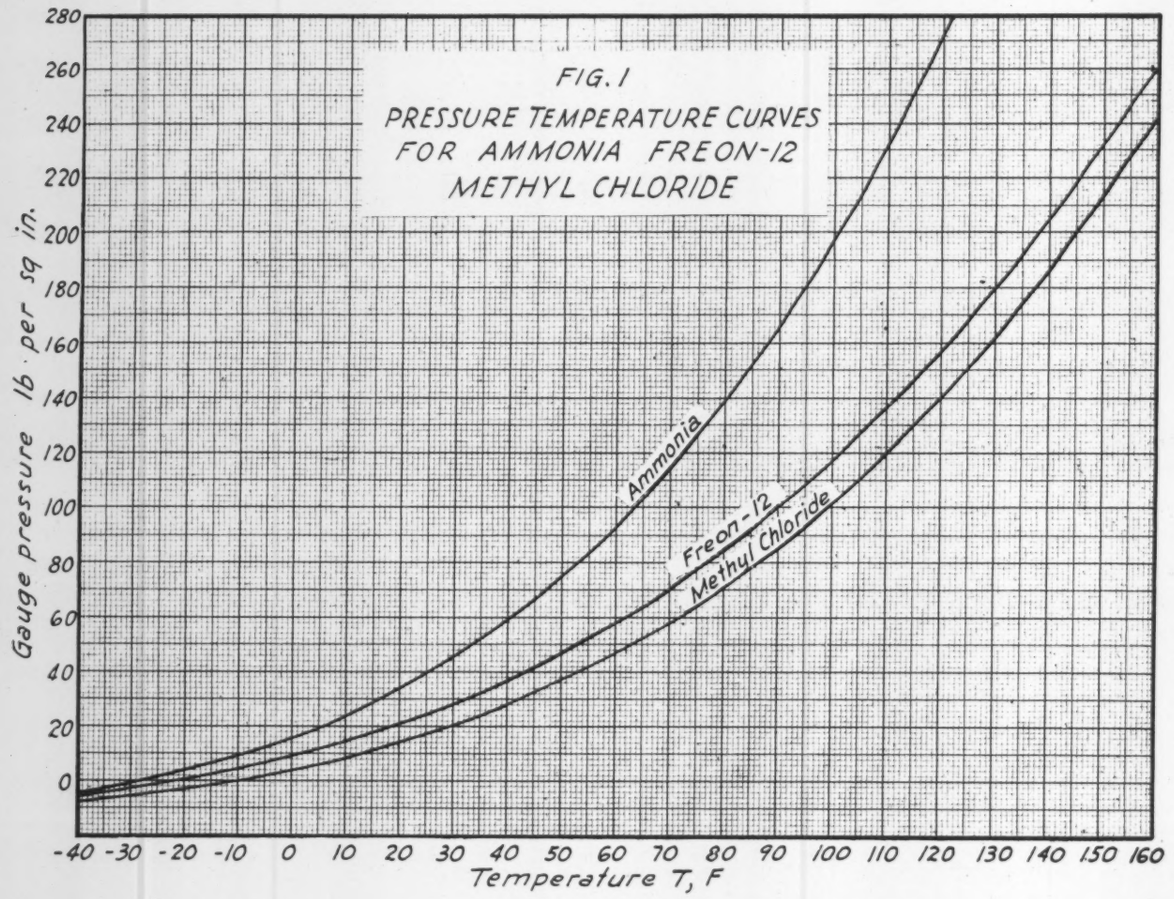
[1] HEATING, PIPING AND AIR CONDITIONING, August, 1937, pp. 492-495; September, 1937, pp. 533-536 and 547.



Methyl chloride liquid is clear and colorless as water and has a density of 61.0 lb per cu ft at 5 F and 55.8 lb per cu ft at 86 F. The refrigerating effect is very fair, ranging from 135 to 155 Btu per lb, from which it is evident that the amount of liquid to be fed from the liquid receiver to the low side evaporators will vary inversely from 1.48 to 1.28 lb per min per ton of refrigeration. If excessive pressure drops in the liquid feed line are to be avoided, the liquid line piping connections should be proportioned so that the liquid velocity will be not over about 2 ft per sec. On this basis, the suitable pipe sizes for liquid lines with various tonnage capacities are shown in Table 1.

Expansion Valves Make or Break Job

The choice of a methyl chloride expansion valve can either make or break a job. There are many makes of expansion valves, both manual and automatic, thermal and magnetic, screwed, flared or flanged, angle or straightway, in a variety of styles with an assortment of orifices for different capacities of liquid flow which give a measure of refrigeration capacity. The designing engineer must be familiar with them and make his choice according to the characteristics of the job in order to balance up the quantity of liquid feed with the low side capacity.

If the plant is a layout on one floor, the differential pressure to be used in making the choice of controls will naturally be the differential between high and low side operating pressures. However, if the plant layout involves several floors, the problem must receive careful consideration for the methyl chloride liquid pressure will decrease rapidly in the liquid line riser due to the static weight of the liquid. In any case, the resultant liquid pressure at any height ahead of the evaporator control valves on any floor minus the evaporator or low side pressure will give the pressure differential across the control valves and consequently the control valves must have sufficient capacity at this differential to match the contemplated load. For this reason, an upper floor evaporator will very often require a much larger valve than the same evaporator on a lower floor location.

This may be illustrated as follows: If we assume we have liquid methyl chloride leaving the liquid receiver of a basement plant at 105 lb pressure and the liquid line rises 60 ft to an evaporator on the fourth floor, the drop in liquid pressure in this riser is approximately 23 lb, leaving a liquid pressure of only 82 lb ahead of the control valves.

82 — 40 = 42 lb drop or differential across the fourth floor controls

Table 1—Suitable Pipe Sizes for Methyl Chloride Liquid Lines

Tonnage Capacity	Size of Liquid Line, In.
0—1	1/4
1—2.5	3/8
2.5—5	1/2
5—8	5/8
8—16	7/8
16—30	1 1/8
30—42	1 3/8
42—60	1 5/8
60—100	2 1/8
100—160	2 5/8
160—230	3 1/8
230—300	3 5/8
300—400	4 1/8
400—600	5 1/8

105 — 40 = 65 lb drop or differential across the basement controls

Now, if we have a load of 6 tons in the methyl chloride evaporator on the fourth floor where the available pressure differential across the control valves is only 42 lb, we will need to use a valve having an orifice of at least 0.22 in. diameter or larger, as indicated by Fig. 2. If the evaporator were in the basement with a permissible differential of 65 lb, we could use a valve with a 0.17 in. orifice if we chose. On the other hand, if a designer disregards the static head in the arrangement of his equipment and selects a 0.17 in. valve for both the basement and fourth floor levels, the control in the basement will easily pass a sufficient quantity of liquid for the 6 ton load but the one on the fourth floor will pass only enough liquid for 5 tons. He may have a 6 ton evaporator but it will not do the job with a 5 ton feed; the only obvious result will be a diminished capacity with a consequent high suction gas superheat to the detriment of the compressor, evaporator and the reputation of the engineer, contractor and manufacturer of the equipment. Subsequent arguments, objections, hold-backs, service calls, loss of time or what have you, involving needless expense could be avoided if a valve of slightly larger orifice were chosen, or, to put it more plainly, if sound engineering replaced hasty guesswork.

Another deterring factor in the job with a liquid riser is this: The liquid methyl chloride is naturally in a stable saturated condition at the liquid receiver king valve at the plant in the basement, but a part of this liquid boils off into gas as the liquid rises in the riser line due to the decrease in static head. Thus, the control valve must pass both liquid and gas and, in some cases, the gas might be as much as 75 per cent as much in volume as the liquid. No data are usually published on the gas passing capacity of a liquid control valve for these are generally tested for liquid capacity but, if we assume it is the same in volume for gas as liquid (which is obviously safe) the valve must pass 75 per cent more in capacity than that listed for its liquid capacity rating in tons of refrigeration in order that the amount of liquid passed through the valve may be sufficient for the load.

It is customary in common practice to allow a 60 lb differential on air conditioning or 70 lb on lower temperature commercial work, but these values are not a constant quantity as shown above, and must be diminished according to the static head due to the layout of the equipment.

It is possible to avoid some of these difficulties by arranging the layout with the compressor on an upper floor and the evaporators on lower floors, in which case the liquid pressure in the liquid line will increase, assuring even more capacity than rating; however, this involves more and greater difficulties—such as more costly electrical and water connections from the basement (where such services are usually installed) to the compressor. This also makes the recovery of oil from the evaporators to the compressor less positive, and for these reasons, it is usually preferred to install the compressor in the basement or below the evaporators.

Magnetic Liquid Shut-Off Valves

Refrigeration plants comprising only one compressor and one evaporator are quite simple in construction and control. However, it takes a multiple system with several compressors and evaporators to bring out the possibilities of modern controls. The magnetic liquid shut-off valve has solved many a problem of this type in both methyl chloride and "Freon-12" systems. These valves also are made in many types with an assortment of orifices of various tonnage capacities and the designer must know his valves to choose wisely for each application. These solenoid valves have rated capacities according to orifice size and pressure drop; Fig. 3 shows some capacity curves for one make. Other makes may vary slightly but the designing engineer can easily procure capacity ratings on any particular type from the manufacturer.

As with the expansion valve, care must be exercised in choosing a magnetic shut-off valve of ample capacity so that the pressure drop across the valve will be within the available differential instead of being excessive or prohibitive. The effect of too small a magnetic liquid shut-off valve is detrimental with methyl chloride just as it is with "Freon-12": (1) It decreases the amount of liquid fed to the evaporator; (2) it reduces the pressure differential for the expansion valve to operate on; (3) it forms a large amount of gas due to the pressure reduction; and (4) all of these accumulatively reduce the refrigeration capacity.

Avoid Bottle Necks

If a plant is to produce its contemplated refrigeration capacity, there must be no "bottle necks." Therefore, it is far wiser to use both liquid expansion and magnetic shut-off valves that are plenty large for the job rather than a size that is questionable or slightly small. It is a very good check on these sizes for the designing engineer to make a rough sketch of the valves and piping system, designating the available pressures and pressure drops in the piping; this precaution will show at once whether the piping and valves are adequate in size for the tonnage demand.

Lubrication and Oil Recovery

Methyl chloride compressors, like "Freon" compressors, are lubricated with a mineral oil of a higher viscosity than ammonia compressors inasmuch as the oil is thinned out in operation. As with "Freon," the oil is miscible with the methyl chloride liquid. It not only mixes with it as a mechanical mixture but a certain amount of liquid is held in suspension as a solution; this amount is rather high at times but fluctuates with the temperature and viscosity. For this reason, the liquid line, controls, etc., do not handle pure methyl chloride but a solution of the liquid refrigerant and oil, so it is essential to avoid oil pockets or traps in the piping system.

Like "Freon," the percentage of solution of liquid in oil is highest on the discharge or high pressure side, where the oil can hold approximately 80 per cent liquid at 100 lb pressure and 90 F. Thus, the oil will not separate from the liquid in the liquid receiver as in the case of ammonia, for instance. However, on the low side, it

FIG. 3
PRESSURE DROP OF LIQUID METHYL CHLORIDE THROUGH SOLENOID SHUT OFF VALVES
1.0" Orifice
0.815"
0.750"
0.625"
0.500"
0.375"
0.250"
0.110"
Capacity in tons refrigeration
Pressure drop lb per sq in.

FIG. 2
PRESSURE DROP VS CAPACITY FOR LIQUID METHYL CHLORIDE THROUGH THERMAL EXPANSION VALVES
0.43" Orifice
0.32"
0.27"
0.22"
0.17"
0.11"
0.06"
Capacity in tons refrigeration
Pressure differential lb per sq in.

can hold approximately only 30 per cent at 32 lb and 40 F, which means that there is a marked separation in the evaporator, suction piping and compressor crankcase. For this reason, oil traps and pockets should be avoided in the suction piping connections. The liquid is fed in the top of the evaporator, and expands downward through the coils to the suction connection at the bottom. The suction line should run downward, if possible, from there to the compressor suction valve so that the flow of oil will not only be induced by the suction gas velocity but will be enhanced by gravity in a positive recovery to the compressor crankcase.

In some instances, the layout may require the installation of a suction riser from the evaporator to the compressor. Here, an oil leg should be installed on the suction outlet from the evaporator so that the oil will be lifted by the suction gas, and the piping so planned that there will be a velocity of at least 1000 fpm or higher. This will cause the oil to climb in the suction riser as ripples along the inside walls of the pipe, which has been demonstrated on a laboratory scale in a system made up with many glass tubing connections where the flow could be observed.

Whenever methyl chloride is used in a flooded system, whether with or without a liquid pump, the vapor is continually boiling off in accomplishing its refrigeration. This leaves a more concentrated oil which will be at the bottom of the cooler inasmuch as the pure oil is greater in gravity than either the pure methyl chloride or a mixture. Here the importance of good oil recovery is accentuated, for the flooded cooler forms a natural oil trap of generous proportions. One good method is to install a small 6 in. diameter by 12 in. oil pot just below the cooler so that the oil may drain from the cooler to the oil pot gradually; a drain connection from this pot to the suction line controlled by a thermal valve is made so that it will pass only oil. This is both positive and automatic. Some engineers may object to a loss in efficiency due to the necessary recompression of a slight amount of methyl chloride entrained with the oil in the suction line. This objection, however, is overshadowed by the importance of having 100 per cent oil recovery, especially on automatic compressors of the small commercial sizes from ½ to 15 hp capacity where the crankcases are relatively small and their oil capacity is rated in pints. In this type, the loss of even a small amount of oil is a serious detriment to the operation of the compressor and is costly, for, if noticed, it results in an unnecessary service call, and, if unnoticed, it means a scored machine.

[A future article will cover methyl chloride suction piping.]

Hospital Air Conditioning Requirements Outlined

THE more important principles of hospital air conditioning as they relate to the welfare of the hospital population are outlined by Dr. C. A. Mills, Professor of Experimental Medicine at the University of Cincinnati, in a recent article.[1] He purposely omits discussion of certain specialized applications (such as those for nurseries and rooms for premature infants, and those for asthma and hay fever), which is not to be construed as belittling their importance, but because they have been thoroughly discussed in other articles.

Primary purpose in conditioning indoor environments is to afford proper control of rate of heat loss from the body, slowing down such loss in winter cold and facilitating it in summer heat; all other phases of air conditioning are distinctly secondary to this control of body heat loss, according to Dr. Mills. We must dissipate heat as long as we are alive, and proper control of that dissipation must be the first principle of intelligent conditioning.

Referring to winter heating, it is pointed out that two radically different groups of individuals must be conditioned by the same atmosphere—the sick patients and the well people who care for them—and that, surprisingly enough, it seems advisable in this case to condition for the well people. Over-heating is harmful for the busy nurse or orderly, while the patients always have the privilege of extra blankets. The value to human health of winter humidification is of dubious proportions to Dr. Mills, except in some cases.

With summer cooling, a different situation exists, as the heat dissipating mechanism often functions less well during illness, and in addition the sick must lie in bed and thus lose half their effective heat dissipating surface because of direct contact with the mattress. It is the patient who is handicapped in the matter of body heat loss, and it is for him that the cooling facilities should be adjusted. Cool air drafts should not strike the patients, as they are unduly sensitive to localized and generalized body chilling. Greatest difficulty in meeting severe summer heat is exhibited by patients at the two extremes of life—infants and the aged; hence the special value of proper summer cooling in hospitals for these two groups.

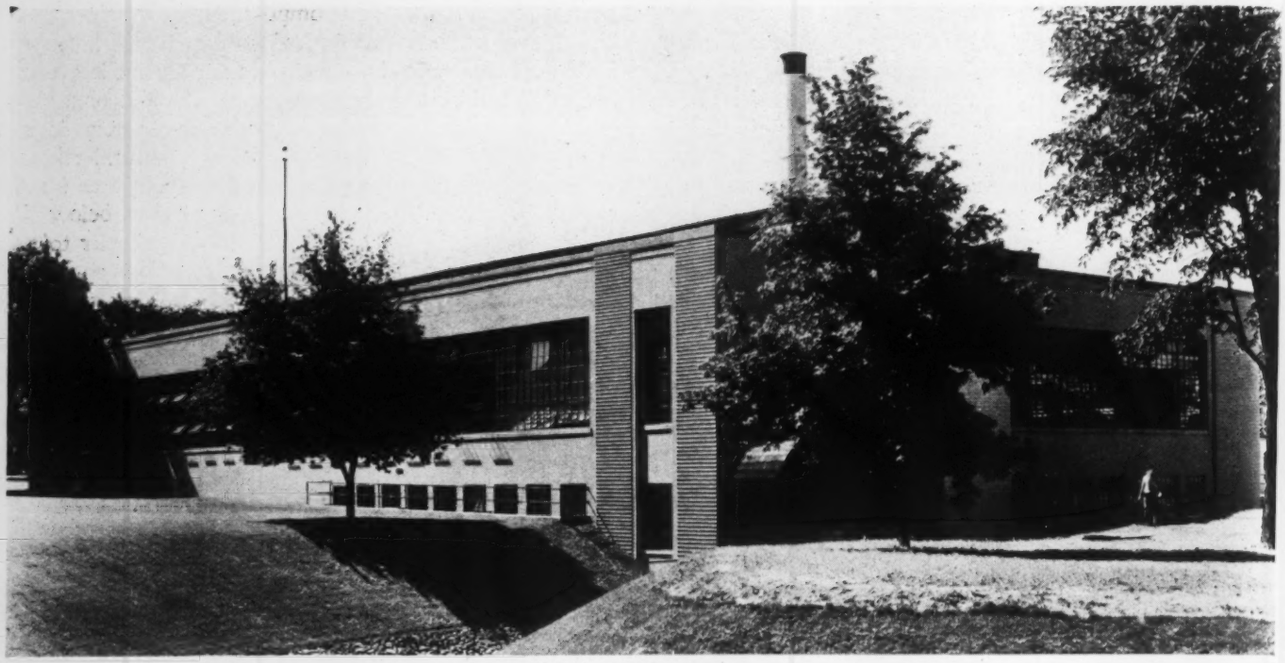
Dr. Mills discusses in some detail the cooling of operating rooms; he believes it seems wise to provide less extensive cooling in the operating room itself and to give greater attention to well graduated cooling facilities in rooms for post-operative care.

Aside from the aesthetic aspects of dust removal, no clear case has yet been made out for air cleaning as a health measure, except with certain definitely irritating industrial dust and gases, Dr. Mills believes. Washing air for the removal of bacteria is a different matter, but great care needs to be exercised for if insufficient change of water is used, the washer may actually increase the bacterial count of the washed air through fouling of the wash water. Air cleansing by electrical precipitation holds great promise, but is still too new for proper evaluation.

Recirculation of hospital air has generally been avoided for fear of spreading contagion from one room or ward to another, but except for certain virus diseases affecting the respiratory tract, this danger has probably been much exaggerated, he feels.

Dr. Mills looks forward to radical changes in conditioning methods—changes to greater control through radiant channels with less emphasis on conditioning the air itself.

[1] *Official Bulletin* of the *Heating, Piping and Air Conditioning Contractors National Association*, September, 1937.



Northville, Mich., plant of the Ford Motor Co., where Ford valves are made

New Type of Unit Furnishes Heat and Power to Ford's Valve Plant

FIRST figures on operating and heat balance data on the "Steamotive" unit recently installed in the Northville, Mich., plant of the Ford Motor Co. indicate the practicability of this new steam-electric generating method. This unit, with a capacity of 10,000 lb per hr of superheated steam at 1250 lb pressure and 950 F supplying a 750 kw turbogenerator, has been carrying the heating and electric load of the Northville plant since April, 1937. It replaced a unit of lower capacity and efficiency.

The operating data given in Table 1 indicate that boiler efficiency is held within limits of 84.12 to 85.03 per cent with boiler steam flow ranging from 9100 to 5500 lb and with output ranging from 775 to 400 kw.

Table 1—Operating Data for "Steamotive" Unit at Northville

Kw	Turbine Water Rate	Boiler Steam Flow	Steam Temp.	Boiler Evaporation	Boiler Efficiency
775	9 32 lb	9100 lb	975 F	13 53 lb	84 12%
425	10 69 lb	6100 lb	836 F	14 75 lb	84 76%
410	10 73 lb	5700 lb	833 F	14 20 lb	84 95%
400	10 82 lb	5500 lb	818 F	13 9 lb	85 03%

Note: Steam flow includes steam to auxiliaries and heating system.

Although the boiler is rated at 10,000 lb per hr of steam, one of its features is the small quantity of water it holds.

	When Steaming	When Cold
Boiler tubes	21 25 gal	53 7 gal
Superheater tubes		8 85 gal
Economizer tubes	5 45 gal	12 55 gal
Steam drum	2 0 gal	5 0 gal
Total	28 70 gal	80 10 gal

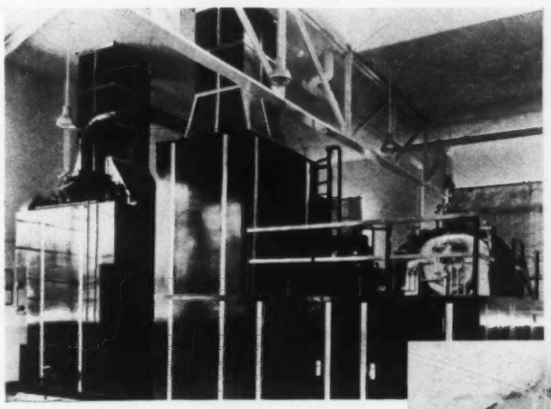
The unit comprises an oil fired, high pressure, forced circulation boiler, auxiliaries, condensing extraction turbine generator, and controls and forms a compact entirely independent installation which takes up a floor space of only 300 sq ft approximately and requires a height to top of boiler of 12 ft.

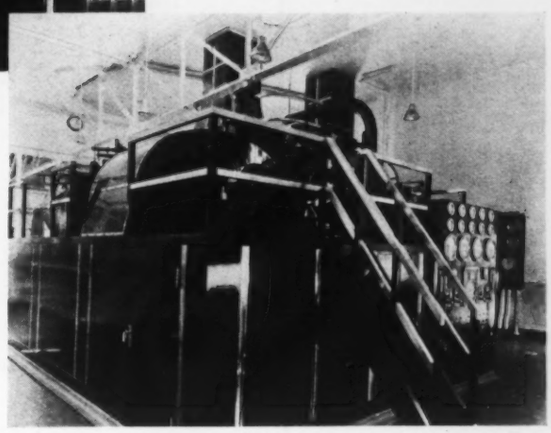
Steam leaves the superheater outlet at a maximum pressure of 1200 lb per sq in. at a total steam temperature of 950 F (about 381 F superheat at the throttle) with a feed water temperature of 350 F.

Quick starting time is realized from this unit, about ten minutes being required from lighting the burner to full load, and wide fluctuations of load can be met very quickly. It is automatically controlled according to the load demands, and the boiler is equipped with automatic ignition as well as a flame failure control. The fuel oil is shut off in case of high boiler pressure, high superheat temperature or high furnace temperature at various points. The oil burner is automatically relighted (the burner being provided with a propane gas torch with dual spark ignition and with a photo-electric flame detector) as soon as conditions are restored to normal.

The water tube boiler is vertically fired from the top, with the flame and gases from the steam atomizing oil burner passing downward, then through two open water cooled passes which require the gases to make three 180 deg turns, and finally upward to the stack passing through sucessively the superheater, economizer and air preheater. The roof, sides and floor of the furnace are formed of closely spaced water tubes of comparatively small diameter. Practically no refractories are employed due to the close spacing of the water tubes, and the boiler

Operating data on the "Steamotive" steam-electric generating unit installed earlier this year to supply the heating and power requirements of the Northville, Mich., plant of the Ford Motor Co. are presented and the unit and its features described





Front and rear views of unit

unit is entirely enclosed by a gas tight, insulated steel casing.

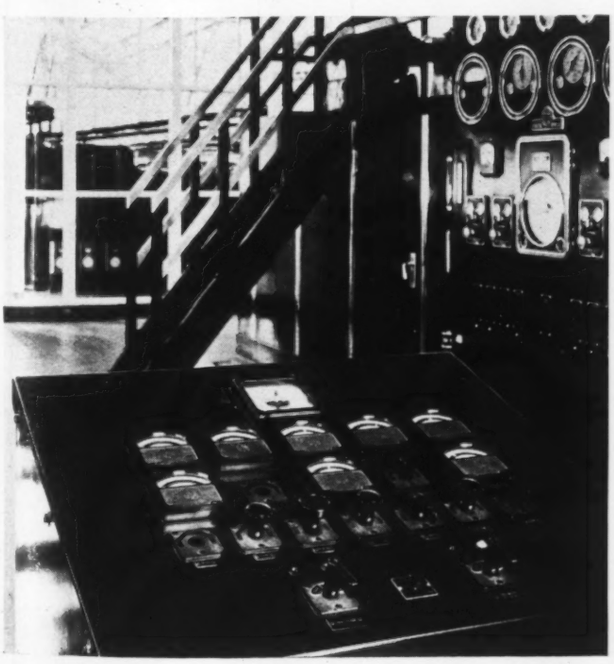
A separating drum is included to separate water and steam; about 10 per cent of the water is spilled from the separator and returned through a heat exchanger to the condenser hot well. Air for combustion is provided by a centrifugal compressor type blower, the air leaving the blower at normal room temperature and 25 in. water pressure and passing through the air heater to the burner. The blower forces the air through the furnace under pressure.

Only evaporated water is introduced into the forced circulation boiler, an evaporator being included in the system to supply the comparatively small amount of make-up that is necessary. Feed water in the condenser hot well is tested and analyzed regularly by Ford chemists and water treatment specialists to assure suitable treatment. Both high and low pressure feed water heaters are utilized.

The condensing turbine generator element is situated alongside the boiler with just sufficient space between boiler and turbine generator for the auxiliary units. An operating platform has been placed in this space for easy access to the equipment.

Steam at 1200 lb pressure at the throttle operates the 937.5 kva, 80 per cent power factor, 750 kw, 3 phase, 60 cycle, 208/120 volt geared condensing extraction turbine generator, which has a 15 kw, 3600 rpm, 125 volt exciter directly connected and exhausting into a surface condenser. This turbine operates at approximately 10,000 rpm and is connected through a single reduction gear to the 3600 rpm a-c generator.

The controller unit. Instrument panel in background



With the turbine generator and exciter mounted a few feet above the shop floor level, sufficient space exists directly below these units for the condenser, vacuum and condenser pumps. Consequently the entire unit is mounted on or above the plant floor and no auxiliaries are below the floor level. The floor supporting the generating equipment has been made separate from the shop floor proper with a clear space of an inch or two between the two. This "island construction" eliminates the possibility that vibration from either area will be transmitted to the other.

A feature of the installation is the co-ordination of the auxiliaries—blower, feed water pump, fuel and lubricating oil pumps—and their operation by a single stage, high pressure, 13,500 rpm turbine. The characteristics of the auxiliaries are such that it has been possible to gear the auxiliaries in fixed ratios and to drive them with the one variable speed turbine. The auxiliary turbine operates at speeds determined by the steam output of the boiler, the blower output being modified by a damper and fuel oil output with a bypass on the fuel oil pump. Output of the feedwater pump is the independent variable from which the speed of the entire set is determined.

Advantages of the unit are the small space required and low weight, elimination of refractory in the furnace (replaced by water walls and insulating blocks), and the quick starting time.

An overshot waterwheel has been installed at the rear of the Northville plant, turned by the water from a small neighboring stream. A small reservoir or pond as well as mill race and tail race have been constructed.

E. Vernon Hill's*

Personal Comments

Saturated Air

STRANGE as it may seem, there is no such thing as "saturated air," if we wish to be accurate in our statements. We hear the expression that "dry air rapidly absorbs moisture" and we speak of the humidity as being 20 per cent, 50 per cent, or some other per cent of saturation. Of course it is generally understood by engineers who are familiar with psychrometry that it is the *space* we actually mean when we say that air is saturated or partly saturated, but even so we find a widespread misapprehension on the part of the air conditioning industry as to what saturation really means.

According to Dalton's first law of gases, the pressure (and consequently the quantity) of gas or vapor which saturates a given space is the same for the same temperature whether the space contains another gas or a vacuum. Many have interpreted this to mean that a space—let us say a cubic foot, to be definite—can be filled with dry air, and then can also be filled or saturated with vapor. As a matter of fact, this is a misapprehension and quite erroneous. If we wish to add moisture or water vapor to a cubic foot of space containing dry air, we must remove from the space an amount of air equal to the amount of vapor introduced; that is, the same number of molecules, for according to Avogadro's hypothesis, all gases at the same temperature and pressure contain the same number of molecules.

It is true that a cubic foot of space containing air can also contain a definite amount of water vapor, but only by increasing the pressure. Molecules don't like to be crowded and if we do add moisture to a space already filled with air, the crowding causes an immediate protest, so to speak, and one of two things must happen—either there will be an increase in temperature or in pressure, probably both.

In air conditioning work however, we are dealing with mixtures of air and water vapor always at a constant pressure of 29.92 inches of mercury, and our charts and tables of air and vapor mixtures are made out for conditions existing at this pressure, which is, of course, atmospheric pressure at sea level. So it leads to misunderstanding when the statement is made that a space containing dry air can be saturated with vapor unless we also state that a part of the air must be removed to make way for the vapor so that the combined pressure of the air and vapor, according to Dalton's second law, will be equal to the original pressure of the air.

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If we look at a table of the relative weights of air and water vapor, in saturated air at different temperatures we find that in a cubic foot of the mixture at 0 F, the weight of the air is 0.086 lb. The weight of the vapor is 0.000068 lb. At 70 F the weight of the air is 0.073 lb, the weight of the vapor is 0.0011 lb. At 140 F the weight of the air has decreased to 0.053 lb, the weight of the vapor increased to 0.0081 lb. When we get to 200 F, the weight of the air is 0.013, the weight of the vapor 0.0297, and when we reach 212 F there is no air whatever in the mixture. It is all water vapor, weighing 0.0373 lb.

What we call saturated air, therefore, at atmospheric pressure, is in reality a mixture of air and water vapor, the amount of vapor in the mixture depending upon its pressure which in turn depends upon the temperature. When the temperature reaches 212 F, the pressure of the vapor equals the pressure of the atmosphere so all air is crowded out, only vapor (or steam, as we now call it) remaining.

So it boils down to the old bromide that two things cannot occupy the same space at the same time—not even gases, unless we are willing to change conditions to accommodate the last arrival.

I fancy I can hear some technical minded reader to whom these fundamental principles are elementary say, "Well, what of it?" So I hasten to point out the moral that adorns the tale.

We should be able to find a better, more accurate and more descriptive term than "saturated air". It misleads the student of psychrometry and gives a false impression that is hard to overcome.

We should also be able to find a better term than the "saturation curve" to describe that border of the chart where wet bulb, dry bulb and dewpoint temperatures meet and merge.

There is also a real need, I believe, for a new psychrometric chart designed primarily for purposes of teaching —a chart which shows graphically and accurately the physical properties of air and water vapor through a wide range in temperatures, and the relationship between them.

Recently, a graduate of a well known technical school was discussing the subject of practical humidification in connection with warm air furnace installation. He made the statement that accurate control of the humidifier in the bonnet of the furnace was a prime essential, otherwise the moisture content of the air might rise to a point that would not only produce discomfort, but cause actual damage to the walls and furnishings of the building. He went on to say that air, at high temperatures, 300 or 400 F possibly, in a gravity system of heating the air, *absorbs so much moisture* that over-humidification must be guarded against.

I took issue with him after the discussion, and stated that high temperature air carried very little moisture. Dropping into his unscientific vernacular I said, "In fact, air at 400 F could not possibly carry more than 1 per cent relative humidity." Some of the bystanders expressed their disbelief and the speaker laughed so long it almost made me wonder whether or not I had misread (or misinterpreted) the excellent tables and formulas in the *Guide*. Perhaps some clear thinking, kind hearted "psychromanic" will settle the controversy.

Selecting the Right Size Heating Boiler†

By Sabin Crocker*

Use of Performance Curves

The use of performance curves in the selection of low pressure heating boilers is recommended by the *A. S. H. V. E.* committee for testing and rating steam heating solid fuel boilers.[4] Such curves should be based on actual tests conducted in accordance with the code formulated by that committee. According to the committee's recommendations performance curves should furnish data on the following items for at least five outputs ranging from maximum down to 35 per cent of maximum: (1) fuel available; (2) combustion rate; (3) efficiency; (4) draft tension; (5) chimney dimensions; (6) flue gas temperature. The only definite restriction placed on setting the maximum output is that priming shall not exceed 2 per cent. These curves are intended to provide the purchaser with complete data regarding performance of the boiler under test conditions. Certain other pertinent information such as grate area, heating surface and proper chimney dimensions are desirable also in forming an opinion of how the boiler will perform in actual service. In using such data for selecting a boiler it should be understood that they apply to test conditions and that equal performance or output may not be realized in service. In selecting a boiler from performance curves, therefore, a reasonable margin should be allowed for decreased output resulting from soot, poor fuel, or attention not the equal of that given on test.

Fuel Burning Rate

Maximum fuel burning rate is an important item to consider in selecting a heating boiler. Inability to burn sufficient coal, oil or gas—as the case may be—will prolong the warming-up period and may result in failure to carry the designed radiation load. With a hand fired coal job this difficulty can be overcome after a fashion by excessive forcing of the fire, provided sufficient draft is available. With a stoker, or with oil or gas firing, the maximum combustion rate is limited by the capacity of the fuel burning equipment, and further forcing is impossible. It is imperative, therefore, to pay even more attention to securing ample capacity with such equipment than it is with manual firing of coal. In any event, it is good practice to select fuel burning equipment which has sufficient reserve capacity to carry the maximum load with some margin to spare. In the following discussion of different types of firing it is assumed that a chimney is provided of adequate proportions to produce the requisite draft and carry away the products of combustion under maximum conditions.

Hand Fired Coal Boilers—With hand fired coal boilers the maximum combustion rate depends on the kind of fuel and the grate area. Higher combustion rates with a given fuel are expected in large boilers than in small ones. This is due in part to ability to burn more fuel per

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†Summarized and revised from a series of three articles published in Heating, Piping and Air Conditioning, February-March-April, 1932

[4]See report of committee in Heating, Piping and Air Conditioning, March, 1930, p. 251.

The actual loads referred to in Table 13 represent the sum of Items 1, 2 and 3 outlined in these articles, rather than boiler manufacturers' ratings. Furnace volumes are based on a heat liberation rate of 50,000 Btu per hr per cu ft of combustion space with a view to insuring smoke less combustion with high volatile fuels.

Table 13—Recommended Setting Heights for Heating Boilers Equipped With Mechanical Stokers

Midwest Stoker Association

Firebox Boilers

Actual Load	2500	5000	7500	10000	12500	15000	20000	25000	30000
A	18″	18″	20″	20″	22″	22″	24″	24″	24″
B	42″	48″	54″	60″	66″	72″	78″	84″	84″

A = Distance from bottom of Water Leg to floor.
B = Distance from Crown Sheet to bottom of Water Leg.

Compact Welded Boilers

Actual Load	2500	5000	7500	10000	12500	15000	20000	25000	30000
A	18″	18″	20″	20″	22″	22″	24″	24″	24″
B	30″	33″	36″	42″	45″	48″	54″	60″	60″

A = Distance from bottom of Water Leg to floor.
B = Distance from Crown Sheet to bottom of Water Leg.

H. R. T. Boilers

HP.	50	75	100	125	150	175	200	225	250	275	300
A	5′-0″	5′-6″	6′-0″	6′-6″	7′-0″	7′-0″	7′-6″	8′-0″	8′-6″	9′-0″	9′-0″

A = Distance from bottom of shell to floor. HP = Installed horsepower.

In the case of the FIREBOX or COMPACT WELDED type boilers the desired setting height can be obtained by combining the *A* and *B* dimensions. The load ratings shown for this class of boilers are actual developed loads in square feet of equivalent cast iron steam radiation and are not manufacturers rating.

The setting heights given for H. R. T. boilers may be used for developed loads up to 50 per cent above normal rating.

The above tables were prepared by the *Midwest Stoker Association* as a guide for architects and consulting engineers in determining the head room requirements for heating plants.

Here is the fifth installment of a new series of "summary sheets," on this and the preceding page. The purpose of these sheets is to make available for quick reference for everyday use information needed in heating, piping and air conditioning work. . . . For complete information, refer to the original article from which these data were obtained, as the purpose of these summaries is not to take the place of the article, but rather to put the essentials into convenient reference form. . . . The Editors will appreciate your suggesting what type of material you'd like presented in this way. . . . Address HEATING, PIPING AND AIR CONDITIONING, 6 North Michigan Avenue, Chicago, Ill.

sq ft of grate area in a large boiler, as well as to shorter firing intervals and more skilled attendance. Residence boilers and other small jobs are expected to operate for comparatively long periods without attention, while larger boilers operated by a fireman can be tended more frequently. Table 11 gives the recommendations of the *A. S. H. V. E.* for practical maximum combustion rates for various fuels and ranges of grate area.

A simplified practice recommendation for steel horizontal firebox heating boilers has been prepared through the efforts of the Division of Simplified Practice of the *National Bureau of Standards* and the *Steel Heating Boiler Institute.* According to this code, the sq ft of 240 Btu radiation represented by Items 1, 2 and 3 (previously described) shall not be more than 14 times the sq ft of heating surface for hand fired boilers burning solid fuel and not more than 17 times the sq ft of heating surface for mechanically fired boilers. On the basis that this ratio is not exceeded, minimum grate area is determined from the following formulas:

For boilers with ratings between 1800 and 4000 sq ft of steam radiation:

$$\text{Grate area} = \sqrt{\frac{\text{Catalog Rating (in sq ft steam radiation)}-200}{23.5}}$$

For boilers with ratings of 4000 sq ft of steam radiation and larger:

$$\text{Grate area} = \sqrt{\frac{\text{Catalog Rating (in sq ft steam radiation)}-1500}{16.8}}$$

No such empirical rules have been established for cast iron boilers, although the tendency is toward the publication of performance curves and catalog data regarding boiler heating surface and guaranteed efficiences at various rates of heat transfer. Typical values for the relation between grate area and heating surface of steel and cast iron boilers are compared in Table 12.

Table 11—Practical Combustion Rates for Relatively Small Coal-Fired Heating Boilers Operating on Natural Draft of from ¼ to ½ In. Water[a]

Sq Ft Grate	Kind of Coal	Lb of Coal Per Sq Ft Grate Per Hr
Up to 4	No. 1 Buckwheat Anthracite	3
5 to 9	No. 1 Buckwheat Anthracite	3½
10 to 14	No. 1 Buckwheat Anthracite	4
15 to 19	No. 1 Buckwheat Anthracite	4½
20 to 25	No. 1 Buckwheat Anthracite	5
Up to 9	Anthracite Pea	5
10 to 19	Anthracite Pea	5½
20 to 25	Anthracite Pea	6
Up to 4	Anthracite Nut and Larger	5
5 to 9	Anthracite Nut and Larger	6
10 to 14	Anthracite Nut and Larger	7
15 to 19	Anthracite Nut and Larger	8
20 to 25	Anthracite Nut and Larger	9
Up to 4	Bituminous	4
5 to 14	Bituminous	7
15 and above	Bituminous	10

[a]Steel boilers usually have higher combustion rates for grate areas exceeding 15 sq ft than those indicated in this table.

Table 12—Typical Values for Sq Ft of Boiler Heating Surface per Sq Ft of Grate Area

Boiler Heating Surface Sq Ft	Sq Ft Heating Surface Per Sq Ft Grate Area	
	Cast Iron Sectional	Steel Portable Firebox Type
15–25	10–12	.....
25–50	10–12	15–17
50–100	10–12	15–17
100–500	11–16	20–30
500–1000	16–25	25–35
1000–3000	.....	35–55

Heating Surface—It will be noted that the tendency is to provide more heating surface for a given grate area in steel boilers than in cast iron. This would indicate that for the same rate of heat transfer, a higher rate of combustion per sq ft of grate area is assumed in the case of steel boilers. On the other hand, for a given rate of combustion per sq ft of grate area, more heating surface is provided in steel boilers. Also for the same rate of heat transfer per sq ft of surface, since more surface is provided, the steaming capacity of a steel boiler per sq ft of grate area is greater than that for a cast iron boiler. *If selection is made on a basis of grate area,* this should result in higher efficiency in a steel boiler than in a cast iron boiler *of the same grate area.* Another interesting condition brought out by Table 12 is the increase in heating surface per sq ft of grate area with increase in boiler size. This fits in with the higher combustion rates per sq ft of grate area in larger boilers and tends toward a uniform rate of heat transfer per sq ft of boiler surface throughout the range of boiler sizes.

The *Heating, Piping and Air Conditioning Contractors National Association* has adopted a set of engineering standards for the selection of cast iron heating boilers. These standards relate connected load to grate width and boiler length in rectangular sectional boilers and extensive tables are given for the allowable load corresponding to various grate widths and boiler lengths. Similar data are given for round cast iron sectional boilers in which credit is given for the extra convection surface obtained by adding more sections. These tables afford a practical basis of selection for conventional types of cast iron boilers whose characteristics are comparatively uniform, but they would not be of value for special designs such, for instance, as those having pin type extended surface, or zig zag water tubes.

Stoker Fired Coal Boilers—Where stokers are installed in low pressure heating boilers, common practice is to size the boiler as for hand firing, using the customary heating surface and grate area called for by the load. The usual grates are removed, of course, and a suitable retort and dead plate installed in their place. The stoker should be selected with a view to obtaining the requisite coal burning capacity by a safe margin. The blower used with the stoker must be able to supply approximately 3⅓ cfm of air (measured at 70 F) for each pound of coal to be burned per hour. Ample combustion space above the fuel bed is highly desirable to insure smokeless combustion, and heights of combustion chambers sometimes are fixed by state or municipal codes. Table 13 gives setting heights recommended for heating boilers.

Recent Changes in National Piping Standards

By Sabin Crocker* and Harvey A. Wagner†

Numerous significant changes in national piping standards have taken place since a previous comprehensive review of the subject has appeared. Everyone concerned with piping will therefore welcome this thorough treatment of standards, for it is a means of posting oneself on what has been done, what is planned for the near future, and of becoming up-to-date on an increasingly important matter

IN 1929[1] and again in 1933[2] articles on standardization of piping appeared in HEATING, PIPING AND AIR CONDITIONING. During the eight years since the first of these articles was published, numerous significant changes have taken place in piping practice to match the ever increasing pressures and temperatures used in central stations, in the oil industry, and in miscellaneous process work. Chief among these changes are the general adoption of welded joints and the increasing use of alloy steels for severe service conditions, both of which departures from past practice have called forth new materials specifications and, to some extent at least, new dimensional standards or the re-rating of old standards. Besides these innovations, new practices have become generally acceptable to the point of consideration for inclusion in American standards, such for instance as the dimensions of loose ring joints, of welding neck flanges and welding fittings, and of flanges and fittings for 2500 lb S.S.P. (steam service pressure), etc.

Dimensional Standards

Since a complete enumeration of piping standardization projects was contained in previous articles, the present article will be confined to important changes in those standards which have received major revisions, and to new standards which have been introduced since 1933, considering in particular those changes involving higher temperatures and pressures.

Steel Flanged Fittings and Companion Flanges for Maximum S.S.P. of 100, 300, 400, 600, 900, and 1500 Lb at a Temperature of 750 F: American Standard Serial No. B16e-1932. Extensive revision of this standard is contemplated, involving the following major items:

1. *Pressure-temperature rating tables* will be included to provide pressure ratings for carbon steel for the several standards at temperatures from 100 to 850 F for steam power piping and temperatures from 100 to 1000 F for oil piping. These ratings, which are included with the present standard as an addendum, are given in Table 1. Proposed ratings for the 2500 lb standard are included. It was recognized that oil piping equipment, particularly at high temperatures, may be subject to serious deterioration by corrosion and that general practice in the oil industry requires that piping be disassembled and inspected frequently. Replacement of valves and fittings is made when certain prescribed limiting thicknesses are reached. This is at such great variance with steam practice that two separate tables of pressure ratings for flanges and fittings were provided for the two services.

2. *Dimensions of flanges and fittings suitable for 2500 lb* per sq in. pressure are being considered. Since installations are proposed and in some cases boilers are being built at the present time for steam pressures in excess of 2000 lb per sq in., a real demand exists for dimensions of flanges and fittings for extremely high pressure. The dimensions for this standard have been worked out on the same design basis as for the preceding pressure standards and hence may consistently be added as an integral part of the standard. Ratings proposed for the 2500 lb standard are shown in Table 1.

3. *Adjusted ratings for alloy steel fittings and flanges* are proposed. Increasing use of higher pressures and temperatures in the power industry and the high temperatures in use in the oil industry have necessitated use of materials with better strength retaining properties at high temperatures than can be realized with plain carbon steels. Users of flanges and fittings at elevated temperatures made of alloy materials have been required to use their best judgment in rating their equipment. It has been necessary for the individual user to select an alloy material which, when made up to the same dimensions as the conventional carbon steel flanges and fittings, would perform with equal satisfaction at the higher temperature.

In view of the meager data available on which to base alloy ratings, the Committee proposes that carbon-molybdenum serve as the fundamental basis for alloy ratings with provision of a note to the effect that other alloys having qualities superior to carbon-molybdenum steel may be given an appropriate higher allowance in their use. Table 2 shows the ratings which are being considered for carbon-molybdenum steel valves and fittings of the same dimensions and facings as for the present carbon steel product as given in B16e-1932. It should be noted that the carbon-molybdenum steel ratings are the same at 900 F as those for carbon steel at 750 F. In other words, the basic ratings for carbon-molybdenum

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[1] "National Standardization of Piping," by Sabin Crocker. HEATING, PIPING AND AIR CONDITIONING, June, 1929, pp. 104-107.

[2] "The Status of Piping Standardization Today," by Sabin Crocker, HEATING, PIPING AND AIR CONDITIONING, a serial from September, 1933, through August, 1934.

steel in the flat gasket joints are reached at 900 F as against 750 F for carbon steel.

4. *The ring joint* is being considered as an optional facing in the standard. The extensive and satisfactory use of the so-called "ring joint" in the oil industry and its increasing use in the steam power field for high pressure, high temperature joints led the committee to consider inclusion of dimensional data for this joint. It consists of two grooves in the adjacent flange faces and a loose ring which fits between them in the grooves. Details of ring and groove dimensions for all of the pressure standards are contemplated. Use of this joint involves different center-to-face dimensions for valve bodies and fittings since the depth of groove has to be added to the basic flange thickness. A typical table of dimensions for the ring joint is given in Table 3. These dimensions are the same as those developed for oil service by the American Petroleum Institute.

Tests which have been conducted by a large valve and fittings manufacturer as well as information obtained under operating conditions indicate that the ring joint does not require so great a load on the bolts to maintain a tight joint, and therefore, less stress in the flange for a given pressure than the regular flat gasket joints. In view of these data, the Committee is considering allowing somewhat higher ratings for the ring joint when used with either carbon or alloy steel flanges and fittings. In alloy steel, for instance, the basic ratings for carbon-molybdenum are set at 900 F for the flat gasket type of flanges and fittings, whereas these ratings are set at 950 F for the ring joint type. Table 4 gives proposed adjusted ratings for American Steel Flange Standards When Made in Alloy Steel With Ring Joints. Table 5 shows proposed adjusted ratings for carbon steel flanged fittings and companion flanges when made with the ring joint. Below 750 F, these values range in most cases from 5 to 15 per cent higher than the flat gasket type joint covered by B16e-1932, ratings for which are given in Table 1. Above 750 F, the values coincide with those given in Table 1 for oil service.

5. *References to materials specifications* will be revised to bring the standard in conformance with latest material specifications, particularly concerning inclusion of data pertaining to alloy steels which has been necessitated owing to addition of alloy steel data.

6. *Dimensions for 150 and 300 lb slip-on welding flanges* are contemplated since this type of flange is permitted by various codes for pressures up to and including 300 lb S.S.P.

7. *Dimensions in van stone joints* for the fillet radius of lap and loose flange, and for the bore of flange have been proposed for standardization. None of these dimensions were contained in B16e-1932.

8. *Dimensions of steel welding neck flanges* are proposed for inclusion in the B16e standard. The welding neck flange standard will provide dimensions for the same pressure standards as included in the B16e standard, that is, from 150 to 2500 psi (psi = pounds per square inch). Tolerances on outside diameter, thickness of hub, etc., are included. As a part of the B16e standard, the same materials are referred to as for the flanged product. The matter of chamfering or beveling of welding ends of welding end flanges and fittings and welding neck flanges occasioned considerable discussion

Table 1—Ratings for Carbon Steel Flanged Fittings and Companion Flanges with Standard Facings as Given in B16e—1932

Steam and Oil Service Pressure Ratings at Temperatures of 750 F and Below

Primary Service Pressure Rating Lb per Sq In.	100	300	400	600	900	1500	2500[a]
Service Temperature Deg Fahr	Maximum Non-Shock Service Pressures, Lb per Sq In.						
100	230	500	670	1000	1500	2500	4170
150	220	480	640	960	1440	2400	4000
200	210	465	620	930	1395	2325	3875
250	200	450	600	900	1350	2250	3750
300	190	435	580	870	1305	2175	3625
350	180	420	560	840	1260	2100	3500
400	170	405	540	810	1215	2025	3375
450	160	390	520	780	1170	1950	3250
500	150	375	500	750	1125	1875	3125
550	140	360	480	720	1080	1800	3000
600	130	345	460	690	1035	1725	2875
650	120	330	440	660	990	1650	2750
700	110	315	420	630	945	1575	2625
750	100	300	400	600	900	1500	2500

Steam Service Pressure Ratings at Temperatures Above 750 F

Primary Service Pressure Rating, Lb per Sq In.	100	300	400	600	900	1500	2500[a]
Service Temperature, Deg Fahr	Maximum Steam Service Pressure Ratings, Lb per Sq In.						
800	85	250	335	500	750	1250	2085
850	70	200	270	400	600	1000	1670

Oil Service Pressure Ratings at Temperatures Above 750 F

Primary Service Pressure Rating, Lb per Sq In.	100	300	400	600	900	1500	2500[a]
Service Temperature, Deg Fahr	Maximum Service Pressure Ratings, Lb per Sq In.						
800	92	275	370	550	830	1380	2300
850	82	245	330	490	740	1230	2050
900	70	210	280	420	630	1050	1750
950	55	165	220	330	495	825	1375
1000	40	120	160	240	360	600	1000

[a] Proposed ratings.

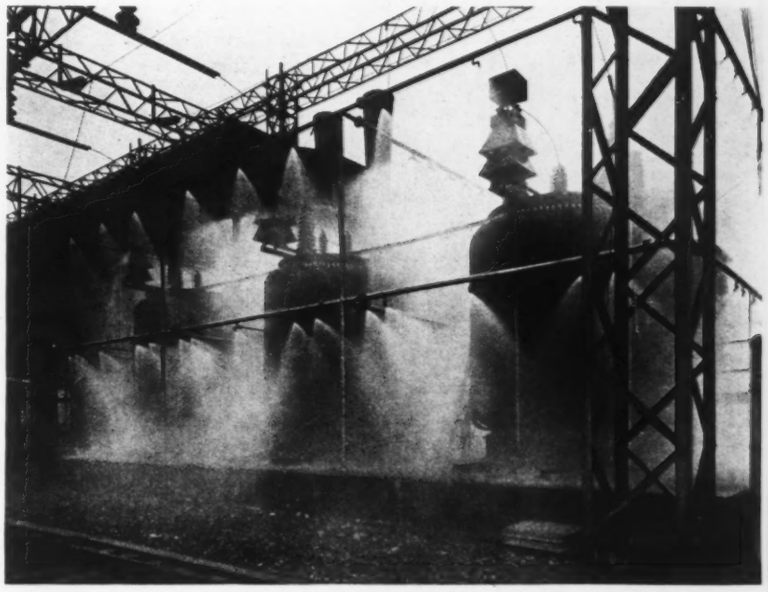
Table 2—Proposed Adjusted Ratings for American Steel Flange Standards When Made of Carbon-Molybdenum Steel[a, b] with Standard Facings

Ratings Contemplate Facings Covered by American Standard B16e-1932 Including Male and Female, Tongue and Groove, Plain Raised Face, and Van Stone.

Fluid	Temperature Deg Fahr	Nominal Working Pressure (Pressure Class)				
		300 Lb	400 Lb	600 Lb	900 Lb	1500 Lb
		Maximum, Non-Shock Working Pressure				
Steam Water Oil Oil Vapor Gas	100	600	800	1200	1800	3000
	150	590	775	1180	1770	2950
	200	580	750	1160	1740	2900
	250	560	725	1120	1680	2800
	300	540	700	1080	1620	2700
	350	520	675	1040	1560	2600
	400	500	650	1000	1500	2500
	450	480	625	960	1440	2400
	500	460	600	920	1380	2300
	550	440	575	880	1320	2200
	600	420	550	840	1260	2100
	650	400	525	800	1200	2000
	700	380	500	760	1140	1900
	750	360	475	720	1080	1800
	800	340	450	680	1020	1700
	850	320	425	640	960	1600
	900	300	400	600	900	1500
	950	265	350	530	795	1325
	1000	190	250	380	570	950

[a] Material in accordance with Grades C1 and F1 of A. S. T. M. Specifications A157-36 and A182-36 for Alloy-Steel Castings and Forgings, respectively. For temperatures above 950 F for steam service, consideration should be given to scaling due to oxidation of these alloys.

[b] Other alloys having superior characteristics may be assigned appropriate allowances in their use.



System for extinguishing transformer oil fires at Trenton Channel

in the Committee, particularly regarding the shape of the bevel on thicknesses greater than ½ in. A subgroup was appointed to investigate and report on this item.

9. *Dimensions for reducing companion flanges and blind flanges* for pressure standards from 150 to 1500 psi are proposed for inclusion in this standard.

10. *A new section on marking* of valves, flanges, and fittings to comply with M.S.S. Standard SP-25-1936 is contemplated. This standard marking system has been developed by the Manufacturers Standardization Society of the Valve and Fittings Industry to cover marking methods for identifying primarily service ratings, materials, sizes, and manufacturer.

While much of the material for revision of this standard is in preliminary form, a revised edition of the standard should be available early in 1938.

Face-to-face Dimensions of Ferrous Flanged Valves: Proposed American Tentative Standard B16i. Although this project was initiated between the federal government and certain valve manufacturers as a war measure in 1917, it lay dormant until 1928 when the A.S.A., through Sectional Committee B16, agreed to take up the work. The standard has been in process of development since that time. Until recently, there has been considerable variation between manufacturers in the design and dimensions of the more common types of cast iron flanged valves such as gates, globes, and checks for all pressures. The differences in face-to-face length were due to a lack of a national standard covering this item, although some manufacturers had adopted substantially the same lengths for certain lines of valves.

Lack of standardized dimensions in the past has been a pronounced handicap in many respects. Drafting departments were unable to lay out piping details until the valve selection had been made and valve prices could not be obtained until detailed layouts were available indicating the number of valves required. Another bad feature involved the necessity of buying the same make of valve when planning an addition to a plant to maintain interchangeability.

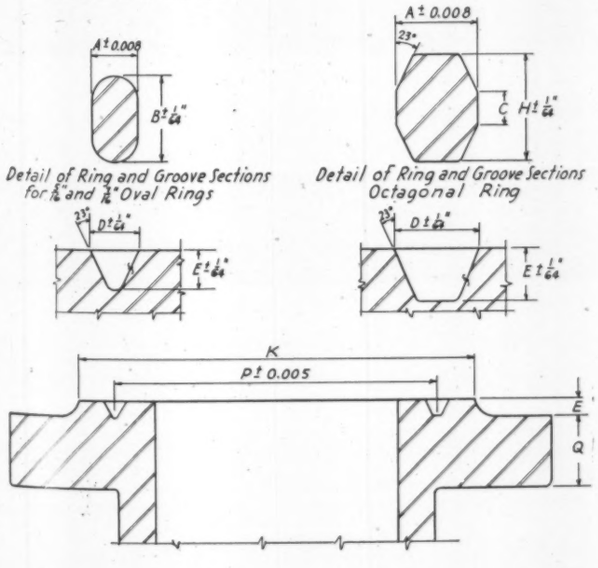
As a first step in standardizing valve lengths, Sectional Committee B16, when it established the original steel flange standard between the years 1923 and 1926, set the center-to-face length of 400 lb, 600 lb, 900 lb, and 1500 lb angle, gate, globe and check valves to agree with the corresponding dimensions of the elbow, tee and cross. At that time it was impossible to secure agreement on the lengths of the 150 lb and 300 lb series since it was customary to cast valve bodies for these standards from existing patterns for cast iron valves.

After several years study with the valve manufacturers, Subcommittee 5 of B16 finally has come forward with a proposed standard covering face-to-face or center-to-face dimensions of ferrous flanged and welding end valves for cast iron wedge and double disc gate valves for 125, 175, 250, and 800 lb standards; steel wedge gate valves for 150, 300, 400, 600, 900, and 1500 psi; cast iron globe and angle valves for 125 and 250 psi; steel globe and angle valves for 150, 300, 400, 600, 900, and 1500 psi; cast iron swing check valves for 125, 250,

Table 3—Proposed Ring and Groove Dimensions—900 Lb Carbon Steel Flanges

Nominal Size	Pitch Diameter of Ring P	Width of Ring A	Depth of Ring (Oval Shaped) B	Depth of Ring (Octag. Shaped) H	Depth of Flat on Octag. Rings C	Width of Groove D	Depth of Groove E	Diameter of Raised Face for Ring Joint or Van Stone K
3	4 7/8	7/16	11/16	.....	.....	15/32	5/16	6 1/8
4	5 7/8	7/16	11/16	.....	.....	15/32	5/16	7 1/8
5	7 1/8	7/16	11/16	.....	.....	15/32	5/16	8 1/2
6	8 5/16	7/16	11/16	.....	.....	15/32	5/16	9 1/2
8	10 5/8	7/16	11/16	.....	.....	15/32	5/16	12 3/8
10	12 3/4	7/16	11/16	.....	.....	15/32	5/16	14 1/4
12	15	7/16	11/16	.....	.....	15/32	5/16	16 1/2
14 O.D.	16 1/2	5/8	7/8	13/16	5/16	21/32	7/16	18 3/4
16 O.D.	18 1/2	5/8	7/8	13/16	5/16	21/32	7/16	20 5/8
18 O.D.	21	3/4	1	15/16	5/16	25/32	1/2	23 3/8
20 O.D.	23	3/4	1	15/16	5/16	25/32	1/2	25 1/2
24 O.D.	27 1/4	1	1 5/16	1 1/4	1/2	1 1/16	5/8	30 3/8

All dimensions in inches.



and 800 psi; and steel swing check valves for 150, 300, 400, and 600 psi. This standard should be available early in 1938 if approved by Sectional Committee B16 of which Subcommittee 5 is a working subgroup. The Manufacturers Standardization Society of the Valve and Fittings Industry has already approved these dimensions.

Proposed Dimensional Standard for Welding Fittings: For practically the same reasons as are valid in the case of face-to-face dimensions for valves, Sectional Committee B16 was urged to appoint a committee to standardize the dimensions of welding fittings. In some cases, as many as four different dimensions were published by five manufacturers for a single item.

So far, standard dimensions have been tentatively proposed for welding reducers, welding heads, and lengths for van stone stub ends. Consideration is being given to dimensions for 90 degree long radius ells, short radius 90 degree ells which will be furnished only in sizes above 12 in., 45 degree ells and welding tees. Tolerances on end-to-end and wall thickness dimensions and out-of-roundness will be considered.

Screw Threads for Bolts, Nuts, Machine Screws, and Threaded Parts: American Standard, Serial No. B1.1-1935. This standard supersedes the May, 1924, American Standard for Screw Threads, Bla-1924. From the viewpoint of those concerned with piping, the most significant change consists of inclusion in the standard of the eight-pitch-thread series. This provides for eight threads per inch on all bolts or nuts in diameters 1⅛ in. and larger. Piping designers and fabricators have long specified that not less than eight threads per inch be used to provide sufficient mechanical advantage in the larger sizes to enable tightening the bolts to a sufficient degree to maintain a pressure tight joint under severe service conditions. It is common practice to sledge up joints by means of a maul to secure a tight joint in addition to the mechanical advantage afforded by the eight-pitch-thread series.

Pipe Plugs of Cast Iron, Malleable Iron, Cast Steel, or Forged Steel: American Standard, Serial No. B16e2-1936. The plugs are intended for use in connection with fittings covered by American Standard 125 lb and 250 lb Cast Iron Screwed Fittings and American Standard 150 lb Malleable Iron Screwed Fittings. Dimensions are covered for metal thickness and threading for square head, bar or slotted head, and countersunk head patterns in nominal pipe sizes ⅛ to 3½ in. These data were published in 1936 as an American Standard.

Proposed Standard for Cast Iron Flanged Ammonia Fittings: Serial No. B16h. Decided changes in the refrigeration industry which adversely affected ammonia equipment led to the abandonment of this standard in 1936. A substantial decline in the manufacture of refrigerating equipment using ammonia in favor of equipment using low pressure refrigerants, and the widespread use of welding and welding fittings, contributed to the curtailment in manufacture of ammonia equipment and therefore, use of ammonia fittings. Since a new standard would have required new metal patterns, jigs, fixtures, etc., which could not have been justified in view of the serious decline in use of ammonia equipment, work on the standard was discontinued.

Cast Iron Pipe Flanges and Flanged Fittings, Class 125: American Standard, Serial No. B16a. The present draft of the standard, which has not yet been approved for publication, constitutes a revision to the former standard issued as B16a-1928. No changes have been made in dimensions from those given formerly except in the body metal thickness for sizes 3 in. and smaller. The steam service pressures have been reduced to 100 lb on the 14 and 16 in. sizes, and eliminated altogether on the larger sizes. Water service pressure ratings have been added for sizes 14 to 48 in. inclusive. Wall thicknesses of the body in sizes 3 in. and below have been reduced and a minus tolerance of 12.5 per cent permitted for all sizes. Bolt lengths have been increased and locations of tapped holes for drain connections indicated. Dimensions have been introduced for double branch elbows. Many other changes of a minor nature have been made. Publication of this draft as an American Standard is expected in 1938 providing approval by Sectional Committee B16 is secured.

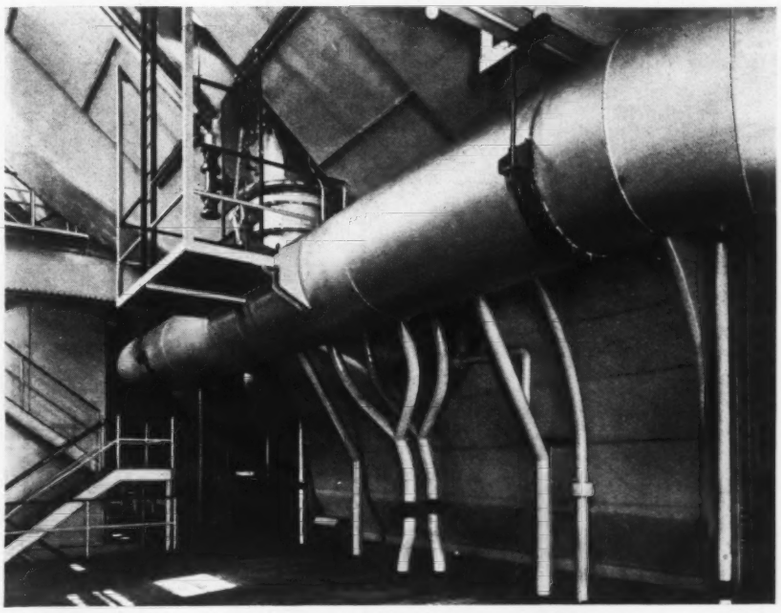
Table 4—Proposed Adjusted Ratings for American Steel Flange Standards When Made in Carbon-Molybdenum Steel[a, b] with A. P. I. Ring Joints

Fluid	Temperature Deg Fahr	Nominal Working Pressure (Pressure Class)				
		300 Lb	400 Lb	600 Lb	900 Lb	1500 Lb
		Maximum, Non-Shock Working Pressure				
	100	720	960	1440	2160	3600
	150	700	925	1400	2100	3500
	200	675	900	1350	2025	3375
	250	650	875	1300	1950	3250
	300	625	825	1250	1875	3125
	350	600	800	1200	1800	3000
Steam	400	575	775	1150	1725	2875
Water	450	550	725	1100	1650	2750
Oil	500	525	700	1050	1575	2625
Oil Vapor	550	500	675	1000	1500	2500
Gas	600	475	625	950	1425	2375
	650	450	600	900	1350	2250
	700	425	575	850	1275	2125
	750	400	525	800	1200	2000
	800	375	500	750	1125	1875
	850	350	475	700	1050	1750
	900	325	425	650	975	1625
	950	300	400	600	900	1500
	1000	250	325	475	725	1200

[a] Material in accordance with Grades C1 and F1 of A. S. T. M. Specifications A157-36 and A182-36 for Alloy-Steel Castings and Forgings, respectively. For temperatures above 950 F for steam service, consideration should be given to scaling due to oxidation of these alloys.
[b] Other alloys having superior characteristics may be assigned appropriate allowances in their use.

Table 5—Proposed Adjusted Ratings for American Steel Flange Standards When Made in Carbon Steel to A.S.T.M. A95 with A. P. I. Ring Joints

Fluid	Temperature Deg Fahr	Nominal Working Pressure (Pressure Class)						
		150 Lb	300 Lb	400 Lb	600 Lb	900 Lb	1500 Lb	2500 Lb
		Maximum, Non-Shock Working Pressure						
	100	275	600	800	1200	1800	3000	5000
	150	255	575	765	1150	1725	2875	4790
	200	240	550	730	1100	1650	2750	4580
	250	225	525	700	1050	1575	2625	4375
	300	210	500	670	1000	1500	2500	4170
Steam	350	195	475	635	950	1425	2375	3960
Oil	400	180	450	600	900	1350	2250	3750
	450	165	425	565	850	1275	2125	3540
	500	150	400	530	800	1200	2000	3330
	550	140	380	505	760	1140	1900	3165
	600	130	360	480	720	1080	1800	3000
	650	120	340	450	680	1020	1700	2830
	700	110	320	425	640	960	1600	2665
	750	100	300	400	600	900	1500	2500
	800	92	275	370	550	830	1380	2300
	850	82	245	330	490	740	1230	2050
Oil	900	70	210	280	420	630	1050	1750
	950	55	165	220	330	495	825	1375
	1000	40	120	160	240	360	600	1000



48 in. blast furnace gas line in boiler room at Delray. A view of the line crossing the Rouge River from the Hanna Furnace Co. is shown on the front cover

Cast Iron, Long Turn Sprinkler Fittings, Screwed and Flanged for Maximum Hydraulic Working Pressures of 150 and 250 Psi: American Standard, Serial No. B16g-1929. Attention of the committee which developed this standard was directed to the need for a series of sprinkler fittings rated at 175 lb. After careful study of design and experience in practice, the committee concluded that fittings made in conformity with the present standard now rated at 150 lb were amply strong for a service pressure of 175 lb. Accordingly, these fittings will hereafter be marked for 175 lb.

Hose Coupling Screw Threads: American Standard, Serial No. B33.1-1935. This standard contains dimensions for screw threads for small hose couplings, ranging from ½ to 2 in. nominal size, intended for garden hose, chemical hose, fire protection hose other than chemical service, steam, water, and air hose with fine threads; and hose couplings with coarse threads. Published as an American Standard in 1935, it enlarges and supplants a tentative standard issued a few years earlier.

Cast Iron Soil Pipe and Fittings: American Standard, Serial No. A40.1-1935. An extensive standard has been prepared covering cast iron soil pipe and about fifty various cast iron soil fittings. Extensive dimensions are included as well as data on tolerances, marking, weights, materials, threads, coatings, etc.

Wrought Iron and Wrought Steel Pipe: American Tentative Standard, Serial No. B36.10-1935. Two years' experience with this standard has demonstrated the pronounced extent to which the obsolete terminology of "standard weight," "extra strong," and "double extra strong" has become intrenched in the usage of the piping trade. Acceptance of the new standard has been slow in spite of the obvious advantages derived from its use by both pipe users and manufacturers.

The primary aim of the standard is to reduce the vast number of commercial thicknesses of pipe to a few standard schedules of thickness which will simplify the stocking problem to such an extent that any of the schedule thicknesses may be secured from jobber's stocks. This aim has not yet been realized.

The more common use of higher pressures and temperatures and the large number of alloy steels being introduced for the more severe service conditions will gradually aid in acceptance of the pipe standard as the only means of avoiding a hopeless complexity of pipe wall thicknesses and the attendant high cost to produce a small quantity of special wall-thickness pipe. An indication of this trend is the recent agreement between the Prime Movers Committee of the Edison Electric Institute and the pipe manufacturers in standardizing on certain of the A.S.A. schedule thicknesses for stocking carbon-molybdenum pipe.

Code for Pressure Piping: American Tentative Standard, Serial No. B31.1-1935. This code, which was prepared by A.S.A. Sectional Committee B31, was published as a Tentative American Standard in 1935. No revision of the code has been undertaken as yet but consideration is being given to revision of certain parts.

A subcommittee of the sectional committee was appointed two years ago to formulate rules governing welding of branch outlets, headers, manifolds, etc., particularly with regard to the reinforcement required and the necessity for stress relief. An extensive test program has been planned by the committee.

[To be concluded. Part 2 will describe recent progress in the development of materials specifications for piping and boiler tubes.]

Units Mounted Above Stage

Air Condition Movie House

The air conditioned atmosphere of the Isis Theater, Forth Worth, Texas, is produced by three quiet condensing units located 25 ft above the stage floor and directly over the screen and sound equipment. The conditioned air is discharged into the theater through 16 ceiling outlets and maintains an average temperature of 76 F when it is 100 F outside. The relative humidity has never exceeded 50 per cent even with 1000 people in the theater.

Due to the fact there was no basement, the only place for equipment was overhead in the stage. Every precaution was taken to prevent sound or vibration entering the theater proper. A steel structure supports the condensing units and is isolated from the building.

Each condensing unit is connected to an individual coil and the system is governed by a step controller operated by a duct type thermostat in the return air duct. As the load increases or decreases the step controller starts or stops compressors as necessary; a humidity limit controller acts as a master control keeping the humidity within comfort limits. The whole system is started and stopped manually by a pushbutton control.

Some Notes on Heating Fuel Consumption Data

IN writing on modern heating system controls primarily designed for economical fuel consumption recently,[1] I pointed out some of the factors which influence the rate of fuel consumption for heating buildings, and also some of the factors which make difficult the comparison of fuel consumption for the heating of different buildings, especially should the buildings be in widely separated localities. Nevertheless, it is often desirable that some method be available for estimating in advance the amount of fuel which a heating system will require, or for comparing the fuel used to heat a building in any given period with the amount burned either to heat the same building during some other period or other buildings in either the same or a different locality. This requires that analysis be made of a great many factors which have a bearing on the subject, and a close scrutiny must be made of these in order to determine which are significant and which are not, and those which must be considered in the investigation of fuel consumption and those which may be disregarded. Finally, there must be evolved some basis for expressing heat or fuel requirements of a building in a manner which will reduce to comparable terms the various expressions encountered in this field.

The present article discusses some aspects of these matters. The material presented may not be any too logically arranged, but the author hopes more than anything else to provoke some thought and comment on the part of those who are interested in fuel consumption, whether it be from any of the three points of view: Heating equipment, heating plant operation, or fuel itself. Surely many men engaged in some phase of these three fields of endeavor have accumulated useful and authentic data from their own experiences. If this data could be assembled and analyzed, important deductions could be made.

It has been shown by Kucera that whereas the calculated heat loss method is the most accurate basis to which to refer calculations of fuel or steam consumption, this method is seldom used because of its complexity, and that of some five other bases that could be established, but two are feasible: Gross building volume and surface of installed radiation. And because divergence of opinion exists as to what should be included in gross building volume, he resorts to the last named for his datum in discussing unit steam consumption for heating office buildings. The square foot of radiation serves fairly well as the unit of measurement in apartment and hotel buildings as well, but it fails when application of it is tried to buildings which are largely heated by forcing air over steam coils or directly over furnaces and thence into the building, as in theaters, schools, churches, auditoria, etc. For theaters which do not have much commercial heating load, an expression of fuel consumption per seat does very nicely. The commercial load should be treated as direct radiation, if the fuel can be distributed between the theater and the commercial load. But any attempt to set up a yardstick that will have comparable application to schools or churches will all too frequently result in untrustworthy conclusions if not complete chaos. Hospitals are generally gauged in size by the number of beds; while such a measure may be suited to some management and administrative problems and practices, it obviously is not a suitable unit for recording data on fuel consumption. Hospitals can perhaps best be included in the office and hotel building group.

Once a unit or datum to which consumption data can be referred is established, it remains to determine the units for expressing fuel consumption. The ideal method, which is applicable and practicable only in those buildings which meter steam or condensate of the heating system, is to use pounds of steam per season. But only a small percentage of commercial and industrial buildings have such records; generally, the only available ones are the fuel deliveries.

For the three principal fuels, therefore, original data are in terms of pounds of coal, gallons of oil, or cubic feet of gas. None of these three is a quantitative statement, for our purposes, unless the calorific value also be given. Hence it follows that a common denominator must be sought, and we perceive it to be in heat units, or Btu's, which is applicable to all fuels and to steam as well. But an important distinction must here be pointed out. Original fuels contain the total heating value; steam in the radiator contains only the "residue" heating value which remains after losses of combustion and other losses are subtracted. This article will refer to the calorific content of the original fuel as total heat, and to thermal content of steam in the radiator as actual heat. We will borrow a term which the gas industry has invented—the *therm* (100,000 Btu)—for expressing both total and actual heat.

Although it will require considerable modification as this discussion proceeds, a generalized statement will here be made: Where the square foot of radiation is used as the basis of reference, fuel consumption should be reduced to an expression of total therms or actual therms per square foot of radiation per 1000 degree days. For theaters, and possibly schools, the seat being the reference unit, the expression must be total or actual therms per seat per 1000 degree days. It will be necessary to review,

[1] HEATING, PIPING AND AIR CONDITIONING, February, 1937, pp. 85-88, and March, 1937, pp. 170-173.

briefly, the theory of the degree day, in order that translation will be possible from one climatic condition to another, but before doing so, a slight digression will be made to examine typical heating plant loads and then to review available data, such as it is.

Because of the confusion involved in continuously distinguishing between fuel burned under a boiler to generate steam and steam purchased from a source outside the building being heated, this article refers to both, indiscriminately, as fuel. The above-mentioned distinction between total heat and actual heat will serve to identify each when required. In most buildings, then, fuel is consumed for at least two purposes: heating the building and heating the hot water supply. In office buildings the hot water load may be light compared to the heating. In apartments the hot water load may be as much as 20 per cent of the total. Where restaurants, barber and beauty shops are supplied with hot water, the building fuel requirements for this commodity rise accordingly. Many hotels and hospitals operate laundries, which of course create extremely high hot water demands, as well as requiring steam for mangels and pressing machinery. Thus, it appears that exact figures on fuel consumption for heating alone cannot readily be secured, because means are not available or steps are not taken to separate heating fuel from other processes. This is possibly one of the reasons that data on the subject are very meagre.

By Kalman Steiner*

Some of the problems involved in comparing fuel consumption data for heating buildings are discussed and the difficulties in using such figures are described.

The second complication in seeking data on fuel consumption for heating is introduced by ventilation. In those buildings which require ventilation, either because of municipal ordinance or actual comfort necessity, no standard practice prevails as to operation of the ventilating system. Many theaters and other buildings having closely spaced seating will recirculate whenever possible. Banking quarters and other types of ventilated spaces where occupant density is not nearly as high can be more liberal in extent of recirculation.

It is now apparent that any statements concerning fuel rates must be qualified by explanation of what is really meant by fuel consumption—whether it be fuel really used to heat a building or whether it includes heat supplied for some other process. For the figures which are given in this paper, the following conditions will be understood: For apartment buildings, the fuel used will include not only that for heating the building but for the twelve months' *domestic* hot water as well; *i.e.*, the hot water furnished to apartments and tenants for kitchen, bath and tenants' laundry, but excluding hot water supply for restaurants, barber and beauty shops and commercial laundries. This is the condition prevailing in probably 90 per cent of apartment buildings, so that most of the fuel data available will reflect that condition, and there being no easy or accurate way of allowing for the domestic hot water, it is included. For all other types of buildings using direct radiation, notably hotels and office structures, the fuel figures will be for heating only, and exclude all other fuel consuming processes. In those cases where good records are kept on heating costs in office and hotel buildings, it is usually on that basis. For theaters, hot water is not a factor, and the commercial heating load has already been discussed. Incidentally, it should be mentioned that one of the best sources of data on heat requirements for water heating and hot water demand in various types of buildings will be found in the *American Gas Association's* "Water Heating."

* President, Ace Engineering Co. and Chief Engineer, Consumers Petroleum Co.

Measure of Good Performance Indefinite

A diligent search of the literature will reveal a most surprising fact concerning fuel for heating. Volumes have been written about fuels themselves, the combustion of fuel, and heating plants, and many authors have expressed facts and experiences about the weather and degree days, but little has been said about what datum can be taken as constituting good results in running a heating system, outside of the obvious observation that the tenants should be maintained in comfort with as little fuel expenditure as possible. Some little information can be had from two organizations that are vitally concerned with this matter of fuel for heating: the *National Association of Building Owners and Managers,* and the *National District Heating Association.* Some figures are cited below from the "Proceedings" of the 29th annual convention of the former and from "Principles of Economical Heating," published by the latter in collaboration with the former.

In a paper which he presented to that convention, Hieronymus stated that 0.7 lb of steam used per 1000 cu ft of volume per degree day is called satisfactory Chicago performance. For a 6000 degree day winter, and assuming a ratio of 100 cu ft of volume to 1 sq ft of radiation, this would be 420 lb of steam per sq ft per season, or on the basis we have outlined above, 0.7 therms actual heat per sq ft of radiation per 1000 degree days. In the discussion following the reading of that paper it was stated that experience in Omaha showed that 10 to 12 lb of 11,000 Btu coal were required per 1000 sq ft of radiation per degree day; this would be 1.1 therms of total heat minimum, or 1.32 therms maximum, per sq ft of radiation per degree day. The cited pamphlet of the *N. D. H. A.* gives the following:

Pounds of Steam Required per Square Foot of Standing Radiation per Degree Day for Heating System Having Different Base-Heating Capacities

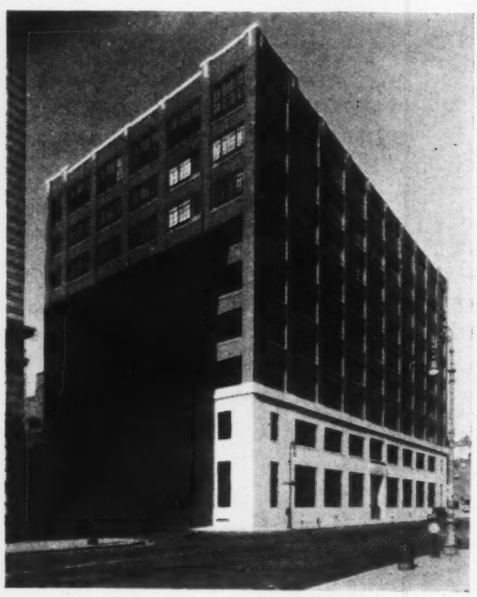
Base Temperature Assumed for Design, F	Max. Temp. Difference Between Indoors and Outdoors, F	Lb Steam per Sq Ft Radiation per Degree Day for 24 Hr Heating to 70 F
—60	130	0.046
—50	120	0.050
—40	110	0.055
—30	100	0.060
—20	90	0.067
—10	80	0.075
0	70	0.086
10	60	0.100
20	50	0.120
30	40	0.150

For 24 hr heating the therms actual heat per sq ft radiation per 1000 degree days would be secured by multiplying the last column by 1000, and dividing by 100 to change pounds of steam to therms.

But seldom indeed is it ever necessary to heat a building for 24 hr per day, the only possibility being hospitals and other special purpose buildings. To illustrate the effect of dropping the temperature during at least part of the 24 hr, assume a condition where the average temperature outdoors is 40 F and the maintained building temperature is 70 F, with a 12 hr drop to 60 F. Then the full heating load is a 30 deg temperature rise and the minimum is a 20 deg rise, so that for 12 hr the load is but 2/3 the average. Putting it another way, a sustained load condition of a 30 deg rise for 24 hr would represent 720 degree hours, and each hour that only 60 F is maintained represents 10/720 reduction in load, or roughly 1.4 per cent. A group of cities is listed below, selected to be representative of some base temperatures appearing in the preceding table. Here, however, are given the average temperatures from October 1 to May 1, the actual therms for 24 hr heating, and the percentage allowance from the 24 hr basis for each hour the maintained temperature is reduced to 60 from 70.

City	Base Temp., F	Av. Temp. Oct. 1 to May 1	Actual Heat on 24 Hr Basis: Therms per Sq Ft Rad per 1000 Degree Days	Per Cent Allowance for Each Hr Maintained at 60 F
Billings, Mont.	—30	34.7	0.60	1.2
Duluth, Minn.	—20	25.1	0.67	0.9
Chicago, Ill.	—10	36.4	0.75	1.2
Columbus, Ohio	0	39.9	0.70	1.4
Portland, Ore.	10	45.9	1.00	1.7
Charleston, S. C.	20	56.9	1.20	3.2
New Orleans, La.	30	61.5	1.50	

To cite Kucera again, he states, for those buildings where temperature is maintained above 70 F, that there is an increase of 3 per cent in heat dissipation per degree of maintained temperature above 70, and furthermore that since degree day data are based on a 70 degree day-time temperature in the building, the actual degree days for such a building will be in excess of the recorded or calculated degree days on the conventional 65 F basis, the load per calculated degree day will be higher.



The preceding data quoted from the *N. D. H. A.* apply principally to office buildings and hotels, and large apartment buildings of the multi-story fireproof type. In the much more common style of apartment, the ordinary three story building, fuel consumption data, as explained above, usually include hot water heating and so that basis was established for this paper. Available data are expressed in various manners. In Chicago, coal men generally figure 2 to 2½ tons of coal per room will heat the average apartment building, including the 12 months' hot water. Oil burner men find a consumption range from 6 to 8 gallons per sq ft of radiation on the same basis. An average for these two fuels, derived from these results, would be about 1.65 therms total heat per sq ft of radiation per 1000 degree days. But this average is subject to fairly wide deviation in individual cases, and obviously so, as a moment's reflection will show. Coal varies from 11,000 to 14,000 Btu per lb and coal combustion will range in efficiency anywhere from under 50 per cent to some 60 per cent for hand firing or better than 65 per cent for stoker firing, while the calorific value of fuel oil lies in the range between 140,000 to 152,000 Btu per gal according to weight per gal, and combustion efficiency for this fuel may vary from 55 to more than 75 per cent, depending on burner type and other conditions.

Data which I have acquired covering a period of years in Chicago on theater heating indicate a range of total heat requirement from 370,000 Btu per seat per 1000 degree days for a house running seven nights with Saturday and Sunday matinee up to 567,000 for houses running matinee and night performances all seven days. These figures include the heating of the theater proper, including backstage, auditorium, foyer and lobby, but excluding all commercial load.

Fuel consumption records for industrial buildings are difficult to analyze, with reference to a standard interchangeable with other similar buildings at least, for various reasons: Of recent years the use of unit heaters places the heating surface in a different classification from direct radiation; usual practice is to calculate the heating capacity to maintain temperatures lower than 70 F; hours of heating vary greatly according to the type of industrial building as well as usage.

In comparing the above building data with figures secured elsewhere than Chicago, a conversion ratio must be applied to account for differences in climatic conditions. This will be the ratio that 80 (—10 to 70) bears to the maximum temperature rise for which the other heating plants have been designed (70—base temperature). Thus, if a heating plant in New York be based on 10 to 70 degree heating, any data based on Chicago degree days should be multiplied by 80/60 to translate to New York conditions.

Variation in Fuel Use Puzzling

And now some curious results which follow from degree day computations can be noted. Outstanding is the apparently remarkable fact that fuel consumption seems to increase, per degree day, as the outdoor temperature rises, both in the case of any individual building when consumption figures for different outdoor temperatures are compared, and also for any two buildings affected by unlike climatic conditions. The latter phenomena has already been explained. Reference to the *N. D. H. A.* table shows that the fuel rate per degree day for a system designed for —10 is exactly half the rate for a system designed for 30 F. This is because a plant capable of heating through 80 degrees has twice the radiation of one capable of heating through only 40 degrees, and so of course any given heat loss, when divided by square feet,

[*Concluded on page* 624]

Rational Psychromatics

By E. Vernon Hill*

Under this formidable title, Dr. Hill tells Fahrenheit how he might have improved his thermometer scale, explains a scale he believes has advantages for air conditioning work, and indicates how a psychrometric chart based on the suggested temperature scale simplifies calculations

IF SOME one were to tell you that water boils at a temperature of 51 degrees and freezes at a temperature of 7.7 degrees you might think his mind was affected, or possibly you would suspect he was using an unfamiliar thermometer scale. The latter is the case as this is the original scale proposed by Gabriel Daniel Fahrenheit over two hundred years ago.

While the invention of the thermometer should probably be credited to Galileo about the year 1612 it was Fahrenheit who developed Galileo's discovery into a practical instrument with a scale that was generally accepted. Fahrenheit determined the scale of his thermometer by establishing zero as the lowest temperature it was possible to obtain at that time. He mixed ice and salt, or salammoniac, to establish this zero point on his thermometer. Twenty-four degrees, at the upper end of the scale, was supposed to be the blood temperature of a healthy man; later he extended the scale upward to the boiling point of water, which was about 51 degrees.

As the thermometer came into general use, the divisions on Fahrenheit's scale were found to be too far apart for accurate results and so each degree was divided into four, bringing the freezing point up to approximately 31 degrees and the boiling point to 203.5. Later more accurate investigations finally placed freezing at 32 and boiling at 212 degrees.

History does not record why Fahrenheit adopted the scale of twenty-four divisions. Possibly he was influenced by the division of the day into twenty-four hours; but the opinion of any air conditioning engineer who investigates the subject would probably be that Fahrenheit should have been content with his original scale, subdividing the degrees to obtain greater accuracy.

The present Fahrenheit scale with 32 as the freezing point of water and 212 as the boiling point, divided into 180 subdivisions, is clumsy and meaningless. His original scale with certain very minor corrections is the most rational and useful scale yet suggested. The centigrade scale with the zero as the freezing point and 100 as the boiling point, while more convenient in many ways, still is entirely arbitrary and without logical justification.

Considering the specific heat of air as 0.241, we can multiply the present Fahrenheit graduations by this decimal and obtain practically Fahrenheit's original scale, which now becomes logical and useful for each degree on the scale will represent the sensible heat in one pound of air. We should bear in mind in this connection that Fahrenheit's equipment was somewhat crude and he could not accurately determine the internal temperature of the human body, and his zero point was, in the light of our present knowledge, entirely arbitrary.

His location of the zero point, however, is quite satisfactory. Zero should be well below freezing and within the range of ordinary air temperatures encountered in heating and air conditioning work. However, had Fahrenheit's zero been 10 degrees lower than it is we would not be compelled to deal with minus temperatures in heating problems.

The engineer, therefore, who will adopt the original (corrected) Fahrenheit scale will no longer need to make calculations every time he wishes to find the sensible heat content of air. He will take the original dry bulb reading of his thermometer.

With this arrangement zero, as previously stated, remains zero as on the present scale, and each degree becomes approximately four degrees of the present scale. One hundred degrees would be 24.1 on the new scale; 200 degrees 48.2, etc. Each degree would be divided into fourths, fifths, or tenths, as desired. Probably the division of each degree into fifths would be the most useful. Such a thermometer is shown in Fig. 1. The scale from zero to boiling is divided into 51.09 degrees with the freezing point at 7.7 and each degree is divided into fifths, making the smallest subdivisions smaller than the one degree division on the present Fahrenheit scale.

Now let us look at the wet bulb thermometer. Here again we find the same arbitrary and meaningless scale. We use the same scale that we use on the dry bulb thermometer and record the wet bulb as a depression below the dry bulb temperature. Suppose we make a new scale for the wet bulb thermometer, graduated not in degrees dry bulb but in degrees of total heat. Such a thermometer is shown in Fig. 2. Note that on the wet bulb thermometer our graduation cannot be uniform as on the dry bulb instrument. This is a slight disadvantage, as graduating the instrument is more difficult.

A New Psychrometer

We now place these two instruments in a suitable frame to construct a whirling psychrometer. We take a reading in air which under the old scales would have a dry bulb, for example, of 64 and a wet bulb of 55. With our new psychrometer, with the sensible and total heat scales, the reading on the dry bulb would be 15 and on the wet bulb 23. This means, of course, that the air where the reading is taken contains 15 Btu per lb of sensible heat and 23 Btu of total heat. Now if we subtract 15 from 23 we obtain 8, which is the latent heat of the air under these conditions. So our dewpoint scale instead of again using the old dry bulb scale would be graduated from zero upward in Btu degrees of latent heat. Zero would, of course, be absolutely dry air.

With a psychrometer so constructed, our dry bulb reading as previously stated would represent the sensible heat per pound of air; wet bulb readings the total heat per pound of air, and the difference would always be the latent heat.

*Director of Research and Education, Refrigeration and Air Conditioning Institute. Member of Board of Consulting and Contributing Editors.

With psychrometers with scales as graduated at the present time, the dry bulb and wet bulb temperatures coincide when the air is saturated. The temperature of the dewpoint also will be the same. This, of course, is illogical. There is no reason why these various values should be the same at the saturation point.

With our new psychrometer, however, the whole picture becomes logical and clear. With no moisture in the air (that is, with absolutely dry air), the wet bulb and dry bulb readings would be the same, as they should be because the air contains only sensible heat. The dewpoint would be at zero, again as it should be because there is no latent heat present. As the wet and dry bulb readings diverge with the addition of moisture to the air the wet bulb increases *above* the dry bulb, because the total heat exceeds the sensible heat. In fact, the wet bulb reading is always above the dry bulb as absolutely dry air is unobtainable and the difference between the two, we say again for emphasis, is the latent heat in Btu for each pound of air.

The Heat Unit Chart

Now let us construct a psychrometric chart using these improved wet bulb, dry bulb, and dewpoint scales. The range of this particular chart under the old system is from 22 to 105 degrees dry bulb, which is equivalent to from 5 to 25 degrees with the new scale we are suggesting. The wet bulb scale under the old system would be from 20 to 80 degrees along the saturation curve, or from 7 to 48 degrees with the new arrangement; the latent heat scale extends from zero at dry air, to 24 degrees.

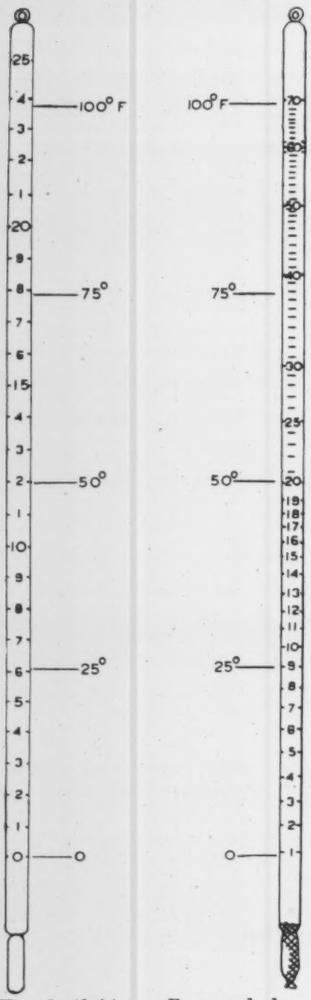


Fig. 1 (*left*) — Proposed dry bulb thermometer, showing sensible heat unit scale. Fig. 2 (*right*) — Proposed wet bulb thermometer, showing total heat unit scale

Any point on this chart now reads correctly with regard to temperatures, wet bulb, dry bulb, and dewpoint, but what is far more important gives us immediately the thermal values which after all are the only important determinations we require in air conditioning work.

Many years ago Willis Carrier told us that when the wet bulb temperature was constant the total heat was constant. We also know that when the dry bulb is constant the sensible heat is constant, and when the dewpoint is constant the latent heat is constant. Quite obviously, therefore, we have two values, two sets of scales, on the psychrometric chart which both mean the same thing.

In order to simplify the chart, therefore, we should discard the scale that is the least useful, so I suggest discarding the old wet bulb, dry bulb, and dewpoint scales and substituting scales that have a definite meaning and usefulness. Such a chart is shown in Fig. 3. You will note in looking at the illustration that it has but one relative humidity curve; this is the curve of 50 per cent. If the chart extended to the left where the saturation curve meets the sensible heat curve of 25 (100 degrees) we would require no relative humidity curves. However, as this left portion is omitted to make the chart of convenient size, the 50 per cent relative humidity curve is included to enable us to find the dewpoint temperature on the part of the chart that is missing.

For example, at a temperature of 21 (new scale) the dewpoint is 14.5 at 50 per cent relative humidity. We know, therefore, that the dewpoint of 21 at saturation is twice this amount or 29. Simple calculations of this kind are easily made because all dry bulb and dewpoint lines are of uniform spacing. Knowing the dewpoint at saturation is 29 we can find the humidity at any point along the dry bulb line of 21 by dividing the dewpoint by 29, or by dividing the dewpoint, times two, by the dewpoint on the 21 degree line at 50 per cent relative.

If the chart were complete in that the saturation curve was extended until it intersected the 25-degree dry bulb line, namely the upper border of the chart, no relative humidity curves would need to be used; in fact I would much prefer the chart without the relative humidity curves as I believe that the use of the term "relative humidity" should be discouraged. It is of no value in psychrometric problems; it conveys no thought or impression to the mind that is not better conveyed by the dry bulb and wet bulb temperatures. It serves only to complicate our conception of psychrometric procedure and our calculations.

It will be further observed in studying this chart that it is much simpler. It will be noted, of course, that the dry bulb, wet bulb, and dewpoint temperatures do not coincide on the saturation curve, which may confuse the reader at first glance—but with a little more familiarity he will appreciate the fact that it gives him a picture of true psychrometric conditions that was not possible in using the old Fahrenheit scale.

Looking at the saturation curve at a wet bulb temperature of 25 you will notice that the dry bulb temperature is 14 and the dewpoint temperature 11. This figure is made up of 14 Btu per lb sensible heat plus 11 Btu latent heat, and it is the total heat and the latent heat above the dry bulb that gives the mental picture of temperature and humidity conditions much more clearly than the old Fahrenheit degrees and relative humidity scales.

I do not cherish, of course, the fond illusion that every engineer is going to immediately discard the temperature scales he has been using and adopt the heat unit scales suggested and so I add, with some regret to be sure, the present dry bulb and dewpoint scales on their appropriate margins for the convenience of the user.

Air Mixtures

Now let us work a few common problems on the heat unit chart to see how it simplifies psychrometric pro-

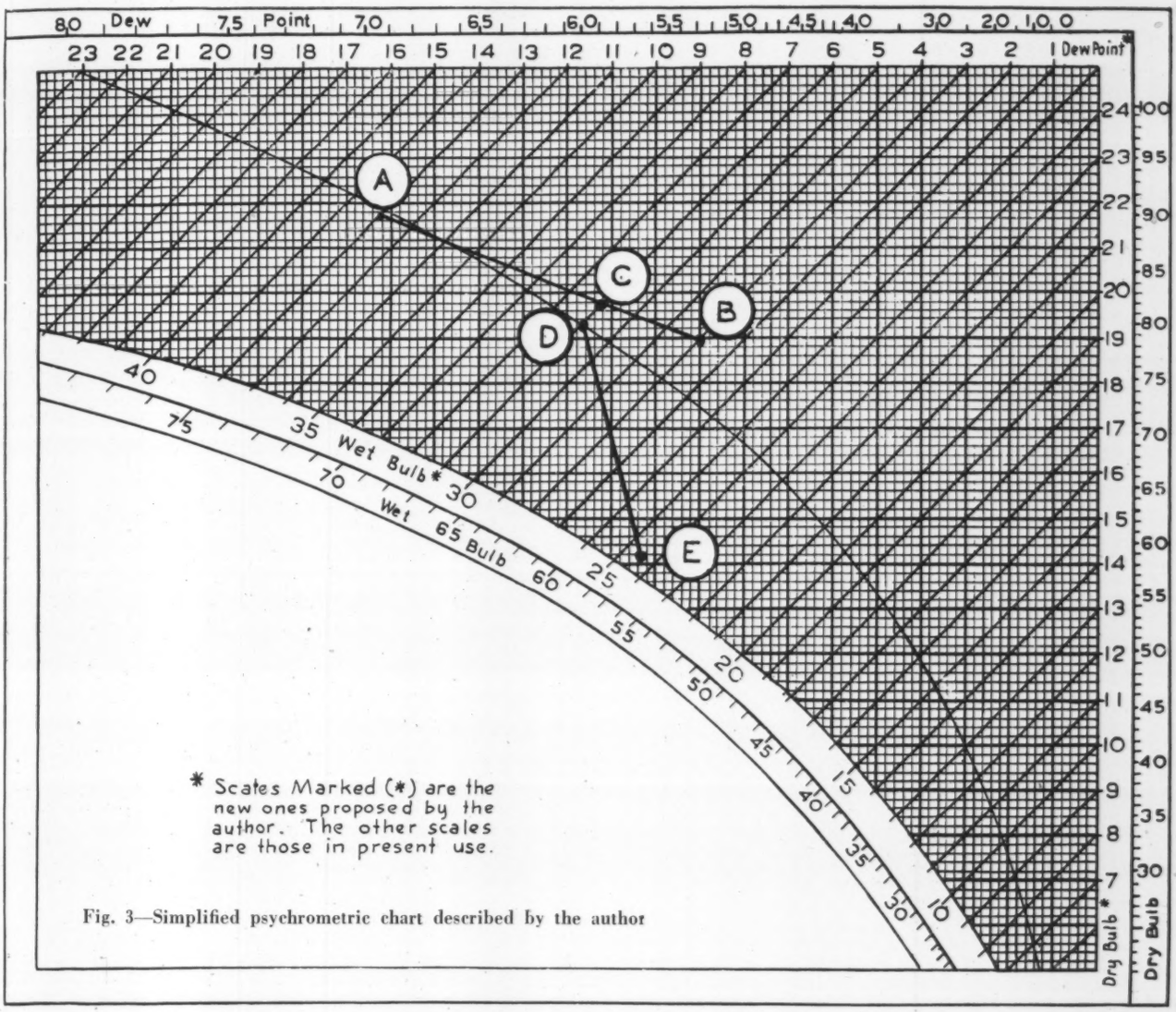


Fig. 3—Simplified psychrometric chart described by the author

cedure. Note point *A* on the chart, which is 90 degree air at a wet bulb of 75. This with the new scale is a dry bulb of 21.7 and a dewpoint of 16.2. We wish to mix three volumes of this air with seven volumes at a temperature of 79 and a wet bulb of 63. The new scale reads 19 dry bulb and 28 wet bulb. We connect the two points with a straight line and step off three wet bulb spaces from *B*, finding immediately that the mixture would be at a wet bulb of 67 and a dry bulb of 82, or with the new scale a wet bulb of 31 and a dry bulb of 19.

We can also pick off directly from the chart all the information we may require regarding this simple procedure. The dry and wet bulb temperatures of the air at point *A* are 21.7 and 38, meaning, of course, that this air contains 21.7 Btu per lb of sensible heat and 38 Btu per lb total heat. The air at point *B* being 19 degrees contains 19 Btu of sensible heat. We can prove our work by taking seven volumes at 19 and adding it to three volumes at 21.7 and dividing by 10. Performing this operation we get 19.8 as the dry bulb temperature of this mixture, but, of course, the graphic solution is much simpler.

Cooling Problems

Suppose we wish to cool the air at point *A* to point *B*. We see at once from counting the wet bulb lines that we must remove 10 Btu per lb of air to accomplish this, and stepping off the squares horizontally we find that this change in temperature conditions will remove 7.2 Btu of latent heat and 2.7 Btu of sensible heat. Of course the solution is apparent from the temperatures: 21.7 — 19 gives us 2.7 as the reduction in sensible heat; the dewpoint of 16.2 — 9 = 7.2 as the reduction in latent heat; and the wet bulb of 38 minus the wet bulb of 28 gives us 10 as the total heat removed from the air. It is obvious from the foregoing that if we transfer our ordinary dry bulb, wet bulb, and dewpoint scales into the new heat unit scales before the solution is attempted, the whole procedure becomes so simple that many problems that are now considered difficult can almost be worked in the head; and if we bring ourselves to discard the old scales and *think* in the new scales mental solution of many of these problems becomes easily possible.

The Heat Ratio

Now let us look at the heat ratio line that William Goodman has recently introduced. It is already a psychrometric classic.[1] We mention in passing that Mr. Goodman's work in simplifying the psychrometric chart,

[1]See "New Uses for the Psychrometric Chart in Simplifying Air Conditioning Problems," by William Goodman, HEATING, PIPING AND AIR CONDITIONING, February, March, April, and May, 1936.

in developing direct and simplified formulas for heat transfer problems, and particularly in his presentation of the latent heat ratio procedure, has done wonders to simplify psychrometric practice. His work deserves more than passing mention.

In Goodman's classic problem he assumes for the design temperature of a room to be air conditioned a dry bulb of 80 and a wet bulb of 67 (see point *D* on the chart). We will assume a room to be cooled where the heat load is 12,000 Btu per hr, of which 2000 is latent and 10,000 sensible. We step off two squares to the right and ten downward, or one to the right and five downward to keep on the chart, and locate the point *E*. Connecting these two points with a line gives us the heat ratio line without the use of a supplementary ruler or table of angles. Any point on the line, it will be understood, will represent air having the proper amount of sensible and latent heat to fulfill the conditions required at point *D*.

If we decide to introduce this air for cooling purposes at a temperature of 60 (14.5) each pound of air will absorb 6 Btu of heat (along line *D-E*) when warmed to the room conditions, and as our total load is 12,000 Btu the air required is 12,000 ÷ 6 or 2000 lb per hr, or 33 lb per min.

If you still think in cubic feet instead of in pounds, multiply 33 × 13.5 to obtain 445.5 as the cfm of air required to cool the room in question and maintain the specified temperature and humidity conditions.

The value of the heat unit chart is that it is arranged to show directly the heat values (total, sensible, and latent heat) which are the only values of importance in the problems we are called upon to solve. The rest of our work in heating and cooling calculations is the interminable and unnecessary conversion of cubic feet into pounds, grains of moisture into pounds, degrees Fahrenheit wet bulb, dry bulb, and dewpoint, into total, sensible, and latent heat.

In conclusion I wish to point out that air conditioning is an industry that will continue to grow and expand for many years to come. It will eventually be one of the great industries of mankind. This is not alone a hope, it is a conviction based, I believe, on sound logic.

Some large industries of today will grow to a certain magnitude and then dwindle or be replaced by the next advancement. There are, however, certain fundamental industries dealing with our very existence — buildings, foods, clothing, and air — and these must and will continue throughout the ages.

With this viewpoint in mind should we not at this time endeavor to simplify and organize engineering practices dealing with this subject? I believe the air conditioning industry is of sufficient importance, and its future is sufficiently promising, to justify the adoption of its own temperature scales, leaving it for time and chance to determine whether or not they will be finally accepted by other industries and the public.

Fuel Consumption Data—

[*Concluded from page* 620]

will give a result twice as great for the second as for the first. But we face another set of facts when considering why an individual system will do a more efficient job, per degree day, in colder weather than in milder weather.

Ask any building executive whose job it is to study and analyze operating cost what is his most vexing statistical problem, as affecting heating, and he is likely to reply that it is the problem of heating a building as efficiently in mild weather as in severe weather. Examine a typical curve plotted with outdoor temperature as one axis and fuel used per degree day as the other, and almost inevitably the curve rises and falls with outdoor temperature. Is this because the efficiency of a boiler plant falls rapidly as the load decreases? If so, then an oversize boiler will be less efficient, over the year, than an undersize one. But surely no good heating man will let pass unchallenged such a deduction. Is it because a heating system—that is, the radiation—is more wasteful at light load than at heavy load? If so, then, in the interest of economical operation a heating system should be installed with the least possible radiation that can be considered permissible. And again trained and experienced men, both designers and operators, will surely object. The author commits himself to no explanation, but merely asks—why?

Many attempts have been made to overcome the tendency last referred to, and many systems have been promulgated for effecting its elimination. One obvious answer to the above question is that in mild weather a building is overheated, or much heat is wastefully dissipated through open windows. Hence any method of temperature control which prevents overheating will tend to correct the shape of the curve that rises on unit consumption with outdoor temperature. A great deal of good result has followed from the installation and use of good control systems. It is probable that the manufacturers of such control systems and devices have accumulated a fair amount of significant data pertaining to fuel consumption, and the effect thereon of many factors other than the very important one of overheating. It is probable, also, that the record sheets of building managers would reveal equally valuable facts. There is a real need for such material to be analyzed so that some sort of expressions might be formulated, upon which anticipation of fuel consumption for heating might be based.

Solving Piping Flow Problems

Eliminating Cut-and-Try Methods When Using the Reynolds' Number

By **William Goodman***

REYNOLDS' numbers have proved a powerful weapon in the solution of pipe line flow problems because of their relation to the friction f in the familiar Fanning equation:

$$P_1 - P_2 = fd\frac{L}{D^5}\frac{U^2}{2g}$$

The Reynolds' number itself is defined and computed by:

$$R_p = \frac{DUd}{u}$$

which can be reduced to the following convenient form:

$$R_p = \frac{4}{\pi}\frac{W}{Du} \quad \text{.....[1]}$$

Charts giving the relation between the friction factor f and the Reynolds' number have appeared in many publications and are a familiar sight to the reader of technical literature. These charts have been constructed by different investigators from analysis of the large number of fluid flow experiments made during the past century.

In order to compute the pressure drop for a given flow and pipe size, Reynolds' number is first computed by the preceding formula. Having the Reynolds' number, the friction factor f can be found by referring to Fig. 1. This friction factor f is then used in the Fanning equation (either in the form given above or in the form given by Formula 4 of Table 1) to compute the pressure drop.

It is apparent that a direct solution of a fluid flow problem is possible only if the pressure drop is to be computed for a known flow and pipe size. On the other hand, if the pressure drop is known, and either the flow or the pipe diameter is to be computed, cut-and-try methods must be used; a direct solution is impossible because the Reynolds' number cannot be computed.

In order to compute the flow through a pipe line for a given pressure drop, Drew, Koo and McAdams[1] presented a plot of the friction factor f against a *modified* form of the Reynolds' number. In this modified Reynolds' number, the factor W is omitted and the given pressure drop p_F is used instead. This eliminates cut-and-try solutions insofar as flow is concerned, but still leaves pipe diameter to be found by such methods.

It seems logical to extend the use of modified Reynolds' numbers to pipe diameters also, thus eliminating cut-and-try methods entirely and providing a direct solution for any one of the three factors: pressure drop, flow or pipe diameter. Such a modified number would have a form different from either of the previous two because the factor D would be omitted.

The two forms of the modified Reynolds' number which are used in this article are:

For finding the flow through a pipe:

$$R_W = \frac{D}{u}\sqrt{p_F dD} \quad \text{.....[2]}$$

For finding the required diameter:

$$R_D = \frac{W}{u}\sqrt[5]{\frac{p_F d}{W^2}} \quad \text{.....[3]}$$

For convenience, the basic and modified forms of the Reynolds' number, as well as the Fanning equation, are tabulated in Table 1. The derivation of the preceding two forms of the modified Reynolds' numbers is given in Appendix 1.

*The Trane Co. Member of Board of Consulting and Contributing Editors.

Part 1.

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Symbols

- D = Diameter of pipe
- d = Density of fluid
- d_1 = Initial density
- d_2 = Final density
- d_a = Average density
- f = Friction factor
- g = Gravitational constant, 32.2
- L = Equivalent length of pipe (includes loss due to fittings and also entrance and exit losses)
- P_1 = Initial pressure.
- P_2 = Final pressure
- $p_F = \frac{P_1 - P_2}{L}$, pressure drop per foot of pipe length
- P_E = Final equivalent pressure
- R_p = Basic Reynolds' number to be used in finding *pressure* drop
- R_W = Modified Reynolds' number to be used in finding *weight* of fluid
- R_D = Modified Reynolds' number to be used in finding required *diameter* of pipe
- u = Viscosity of fluid
- U = Velocity of fluid
- W = Total weight of fluid flowing through pipe in a unit of time

Note: For units, see bottom of Table 1. L is in feet, and density is given in lb per cu ft.

[1]Drew, Koo and McAdams, *Transactions, American Institute of Chemical Engineers*, Vol. 28, 1932, pp. 56-72.

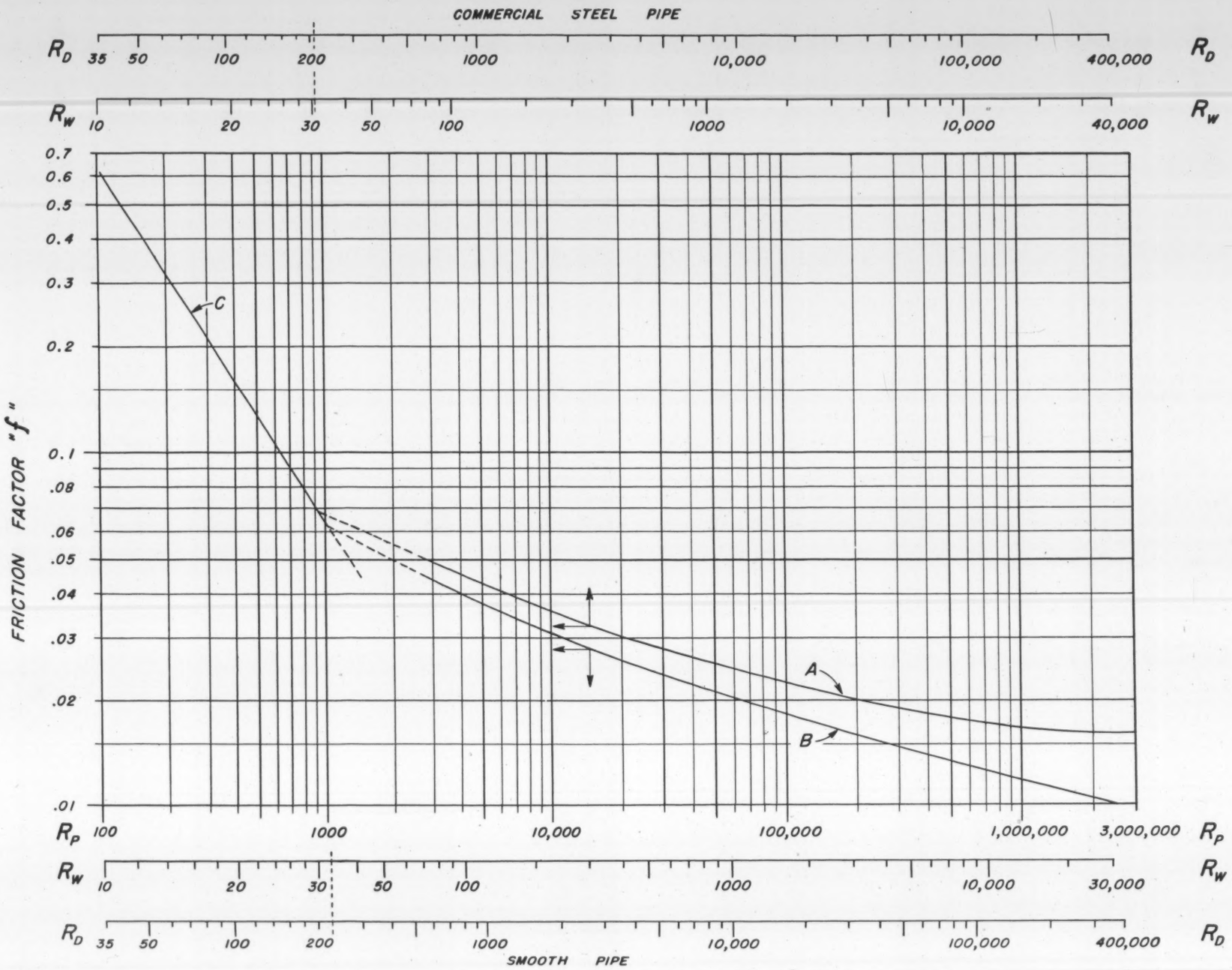

COMMERCIAL STEEL PIPE
R_D 35 50 100 200 1000 10,000 100,000 400,000 R_D
R_W 10 20 30 50 100 1000 10,000 40,000 R_W
FRICTION FACTOR "f"
0.7
0.6
0.5
0.4
0.3
0.2
0.1
.08
.06
.05
.04
.03
.02
.01
C
A
B
R_P 100 1000 10,000 100,000 1,000,000 3,000,000 R_P
R_W 10 20 30 50 100 1000 10,000 30,000 R_W
R_D 35 50 100 200 1000 10,000 100,000 400,000 R_D
SMOOTH PIPE

Table 1

To Find:	Consistent Units*	Mixed Units*
P_1-P_2	Formula 1: $R_p = \left(\frac{4}{\pi}\right)\frac{W}{Du} = 1.273\frac{W}{Du}$	Formula 1a: $R_p = 378.8\frac{W}{Du}$
W	Formula 2: $R_W = \frac{D}{u}\sqrt{p_F dD}$	Formula 2a: $R_W = 429.6\frac{D}{u}\sqrt{p_F dD} = 429.6\frac{D^{3/2}}{u}\sqrt{p_F d}$
D	Formula 3: $R_D = \frac{W}{u}\sqrt[5]{\frac{p_F d}{W^2}}$	Formula 3a: $R_D = 344.7\frac{W}{u}\sqrt[5]{\frac{p_F d}{W^2}} = \frac{344.7}{u}\sqrt[5]{p_F d W^3}$
	Formula 4: $P_1-P_2 = \left(\frac{4}{\pi}\right)^2 f\frac{L}{D^5 d}\frac{W^2}{2g} = 0.02518 f\frac{L}{D^5}\frac{W^2}{d}$	Formula 4a: $P_1-P_2 = 0.01209 f\frac{L}{D^5}\frac{W^2}{d}$
	*Units W = pounds per second D = feet u = pounds per foot second P = pounds per square foot p_F = pounds per square foot per foot	*Units W = pounds per minute D = inches u = centipoises P = pounds per square inch p_F = pounds per square inch per foot

Friction Factor Chart

Before the modified Reynolds' numbers defined by Formulas 2 and 3 can be used to find the friction factor f, it is necessary to have a chart on which f is plotted against these modified numbers. The chart, commonly seen, of f versus the basic Reynolds' number defined by Formula 1 cannot be used. A separate chart, or some combination of independent scales, must be used for f versus each form of the modified Reynolds' numbers. Although there are several obvious ways in which these relationships can be plotted, the form presented in Fig. 1 is satisfactory for most purposes.

In this chart two scales are provided along the top and three along the bottom. Those at the top are to be used only with the upper curve marked A. Those at the bottom are to be used only with the bottom curve marked B. The basic Reynolds' number defined by Formula 1 is the same for both curves A and B, and hence is shown only at the bottom of the chart. However, the top and bottom scales for the modified Reynolds' numbers are different. The reason is that, in computing these modified forms, the relation between the factor f and the basic Reynolds' number is used as described in Appendix 1. Inasmuch as the friction factor f for any given basic Reynolds' number is different for the two curves, different scales of modified numbers must be used for each of the curves.

Either the upper or the lower scales may be used for the streamline curve marked C, as they are the same. The reason for this is that streamline flow is not affected by the condition of the interior pipe surface. The light dotted lines drawn across the scales of modified numbers mean nothing insofar as the use of the chart is concerned. They merely serve to separate these scales into a "streamline" and "turbulent" part. Different formulas were used to compute the two parts of each scale of modified numbers.

The dotted portions of the curves A and B of Fig. 1 show the range of basic Reynolds' numbers for which the flow is indeterminate; that is, it may be either streamline or turbulent. However, in this range the values of f as read from the "turbulent" curves A and B should be used for the sake of safety.

Fig. 1

Curve A is for clean commercial steel and cast iron pipe.
Curve B is for smooth pipe, such as brass, copper, tin, etc.
Curve C is for streamline flow in any kind of pipe.
The friction factor for large size commercial steel and cast iron pipe is lower than the average value given by the curve marked A. The larger the pipe size, the closer the values of the friction factor for commercial pipe will approach the values given by Curve B. It is difficult to give an exact pipe size beyond which Curve A should be used, but it is probable that the friction factor for commercial pipe above approximately 8 in. in size will be given more accurately by Curve B than by Curve A.

Computing the Flow

When the flow through a given size pipe is to be computed for a given pressure drop, first compute the modified Reynolds' number R_w by means of Formula 2. Then use the R_w scale in Fig. 1 to determine the friction factor f. With f known, Formula 4 can be used to find the weight of fluid flowing.

On the other hand, if the pressure drop and desired flow are known and the necessary diameter is to be found, compute the modified Reynolds' number R_D by Formula 3. Then use the R_D scale in Fig. 1 to find the friction factor f, after which Formula 4 can be used to find the pipe diameter.

It is important to note that the pressure drop p_F which is used to compute the modified Reynolds' numbers R_w and R_D is the *pressure drop per foot of pipe length*, or

$$p_F = \frac{P_1 - P_2}{L} \quad \text{.....[5]}$$

Formula 4 is customarily used for solving for either the pipe size or the flow after the friction factor f has been determined. However, there is a method of solving for either the pipe size or the flow which does not require the use of Formula 4, and which is easier to manipulate arithmetically.

By inspecting the scales of Reynolds' numbers of Fig. 1, it is apparent that for each value of the basic Reynolds' number R_p along any one curve, there is one and only one corresponding value of each of the modified numbers R_w and R_D. Therefore, after the modified Reynolds' number has been computed by either Formula 2 or 3, the corresponding value of the basic Reynolds' number can be read from the scales of Fig. 1. Then with the basic Reynolds' number known, Formula 1 can be solved easily for either W or D, whichever is required. This

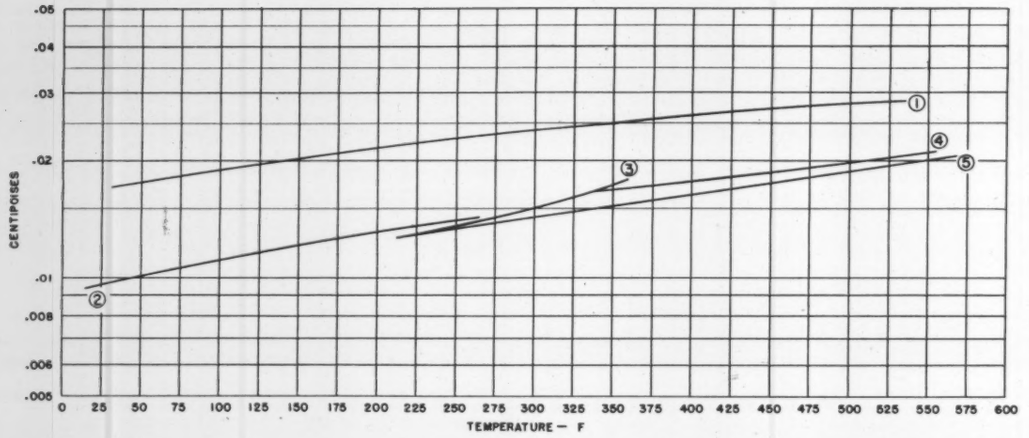


Fig. 2—Viscosities of a few gases and vapors

Curve No.	*Substance*	*Source of Data*
1	Air	Int. Critical Tables
2	Ammonia	Reed & Ambrosius, HEATING, PIPING AND AIR CONDITIONING, June, 1930.
3	Saturated steam	Schüle—Technical Thermodynamics
4	Steam 100 lb ga press.	Schüle—Technical Thermodynamics
5	Steam 0 lb ga press.	Schüle—Technical Thermodynamics

will be found to be considerably easier than solving Formula 4 for the same quantities. Example 1 illustrates the method.

Example 1: Find the weight of saturated steam which can flow through a 4 in. standard weight, commercial steel pipe 650 ft long, if the total pressure drop is not to exceed 3 lb per sq in. The initial steam pressure is 100 lb ga.

Solution:

From Marks & Davis' steam tables, density of saturated steam at 100 lb ga = 0.257 lb per cu ft.

From Fig. 2, viscosity of saturated steam at 100 lb ga = 0.0165 centipoises.

From Table 2, for 4 in. standard weight steel pipe D = 4.026 in.

$$D^{3/2} = 8.078$$

$$p_F = \frac{P_1 - P_2}{L} = \frac{3}{650}$$

$$= 0.00461 \text{ lb per sq in. per ft of pipe length.}$$

As the weight W is to be found, Table 1 shows that the modified Reynolds' number should be computed by either Formula 2 or 2a.

$$R_w = 429.6 \frac{D^{3/2}}{u} \sqrt{p_F d} \quad \text{.....[3a]}$$

Therefore,

$$R_w = 429.6 \times \frac{8.078}{0.0165} \sqrt{0.00461 \times 0.257}$$

$$R_w = 429.6 \times \frac{8.078}{0.0165} \times 0.0344 = 7240$$

Referring to the top scale of Fig. 2, for R_w = 7240,

$$R_p = 430{,}000$$

From Formula 1a,

$$R_p = 378.8 \frac{W}{Du}$$

$$430{,}000 = 378.8 \times \frac{W}{4.026 \times 0.0165}$$

$$W = \frac{430{,}000 \times 4.026 \times 0.0165}{378.8}$$

$$= 75.3 \text{ lb per min (4520 lb per hr)}$$

The method illustrated by the preceding example can also be used to find the diameter D for a given flow and pressure drop, except that Formula 3 would be used instead of Formula 2 for finding the modified Reynolds' number. The method of using Reynolds' numbers for solving for either W or D is simpler than the use of the Fanning equation.

Flow with Changing Density

Strictly speaking, the Fanning equation (Formula 4 of Table 1) is valid only for a fluid whose density is constant. Steam and all other vapors and gases expand as the pressure in the pipe decreases because of friction. As a result, the volume of a vapor or gas at the outlet of a pipe is greater than at the inlet. Where the drop in pressure is only a small fraction of the initial pressure, the change in volume will be negligible. Under these condi-

Table 2—Constants for Inside Diameters of Pipe
(*Inches*)

Nominal Pipe Size	Standard Weight Steel Pipe			Type L Copper Tubing		
	D	$D^{3/2}$	D^5	D	$D^{3/2}$	D^5
1/8	0.269	0.1395	0.001408	.....	.....	.....
1/4	.364	.2196	.006390	.....	.....	.....
3/8	.493	.3461	.02911	0.430	0.2820	0.01470
1/2	.622	.4905	.09311	.545	.4024	.04807
3/4	.824	.7480	.3799	.785	.6955	.2981
1	1.049	1.074	1.269	1.025	1.038	1.132
1 1/4	1.380	1.621	5.003	1.265	1.423	3.238
1 1/2	1.610	2.043	10.82	1.505	1.846	7.721
2	2.067	2.972	37.74	1.985	2.797	30.82
2 1/2	2.469	3.879	91.75	2.465	3.870	91.00
3	3.068	5.374	271.8	2.945	5.054	221.5
3 1/2	3.548	6.683	562.4	3.425	6.339	471.2
4	4.026	8.078	1058.0	3.905	7.717	908.1
5	5.047	11.34	3274.0	4.875	10.77	2754.0
6	6.065	14.94	8205.0	5.845	14.13	6821.0
8	8.071	22.93	34247	.....	.....	.....
8	7.981	22.55	32385	.....	.....	.....
10	10.192	32.54	109809	.....	.....	.....
10	10.136	32.30	107117	.....	.....	.....
10	10.020	31.72	101002	.....	.....	.....
12	12.090	42.04	258412	.....	.....	.....
12	12.000	41.57	248832	.....	.....	.....

tions, Formula 4 is satisfactory and has been used for many years for steam and other gases.

However, where the pressure drop due to friction is a substantial part of the initial pressure, the use of Formula 4 will lead to errors. Where the flow takes place at substantially constant temperature, but the final pressure is considerably below the initial pressure, with a consequent change in the density of the fluid, the following formula has been used for many years. Its derivation can be found in several text books.[2]

$$P_1^2 - P_2^2 = 2\left(\frac{4}{\pi}\right)^2 f \frac{L}{D^5}\frac{P_1}{d_1}\frac{W^2}{2g} \quad \text{.....[6]}$$

This formula can be reduced to the simpler form given below. Although Formula 7, below, is well known, the reduction from Formula 6 to 7 is rarely given. For those who are interested, it appears in Appendix 2.

$$P_1 - P_2 = \left(\frac{4}{\pi}\right)^2 f \frac{L}{D^5 d_a}\frac{W^2}{2g} \quad \text{.....[7]}$$

Notice that this formula is exactly the same as the Fanning equation (Formula 4 of Table 1) except for the value of the density, d. In Formula 4, the density is constant and equal to the initial density; in Formula 7, since the density varies along the pipe, the value which is used is the average density, d_a, or what amounts to exactly the same thing, the density at the average pressure. The average density can be determined from either of the following two formulas, whose derivation is obvious from the material given in Appendix 2.

$$d_a = \frac{d_1 + d_2}{2} \quad \text{.....[8]}$$

Also

$$d_a = \frac{P_a}{BT} \quad \text{.....[9]}$$

Where

$$P_a = \frac{P_1 + P_2}{2} \quad \text{.....[10]}$$

(B = constant for perfect gas law, $Pv = BT$, and T = absolute temperature)

If the initial and final pressures are known, the average density of the vapor or gas can be computed from one of the preceding formulas, and the chart of Fig. 1 together with either Formula 2 or 3 may then be used to find either the required pipe size or the weight which a given pipe can deliver, depending upon which of the two is unknown. The method is exactly the same as the one illustrated in Example 1.

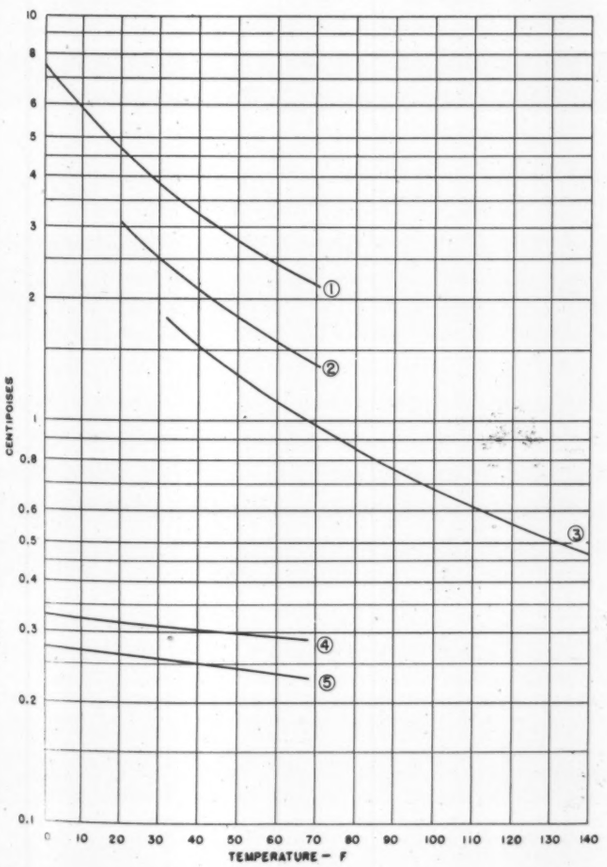
However, when it is necessary to compute the pressure drop for a known weight of fluid flowing through a given pipe size, Formula 7 cannot be used because the final pressure is unknown and, hence, the average density cannot be computed. Under these conditions, Formula 6 is usually used. Nevertheless, the simpler Formula 7 can be used even for problems of this type by utilizing the "equivalent pressures" to be described next month.

[To be continued]

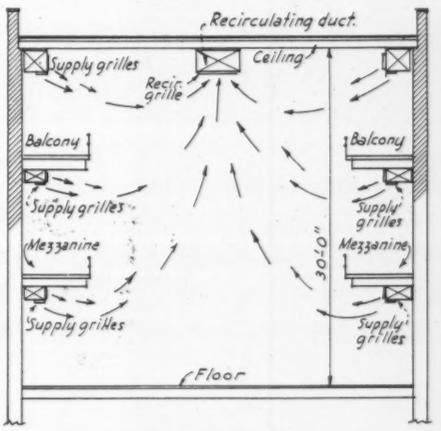
[2]For instance, Goodenough's "Principles of Thermodynamics."

Fig. 2a—Viscosities of a few liquids

Curve No.	*Substance*	*Source of Data*
1	Calcium chloride 1.2 specific gravity	Gould & Levy, Univ. of Ill. Bulletin No. 182.
2	Calcium chloride 1.1 specific gravity	Gould & Levy, Univ. of Ill. Bulletin No. 182.
3	Water	Int. Critical Tables.
4	Methyl chloride, 99.6 lb absolute press.	Refrig. Data Book, 1937-38.
5	Ammonia, 171 lb absolute press.	Refrig. Data Book, 1937-38.



Duct Scheme for Large Drug Store



Rough sketch indicating method of air distribution for new Walgreen store at Miami. Because the main part of the building has three different levels (main floor, mezzanine, and balcony) all within the same room, the scheme illustrated was employed to prevent air stratification

Applying *Air Conditioning* to an Existing Building

By M. Kennedy*

THE air conditioning system of the Brix Building, Fresno, Calif., presents a number of unusual features of interest to architects, engineers, and building executives. The building is a six story structure with a department store occupying the main floor which is not air conditioned. On the five floors above the first there are 190 offices with a floor area of 64,100 sq ft and a total occupancy of about 400 people. This building was originally partially air conditioned by a system of adiabatic or evaporative cooling, wherein air is passed through a water spray in which the water is continually recirculated, so that when the entering unsaturated air passes through the spray a part of the water is evaporated at the expense of the sensible heat, *i.e.,* by reduction of the dry bulb temperature.

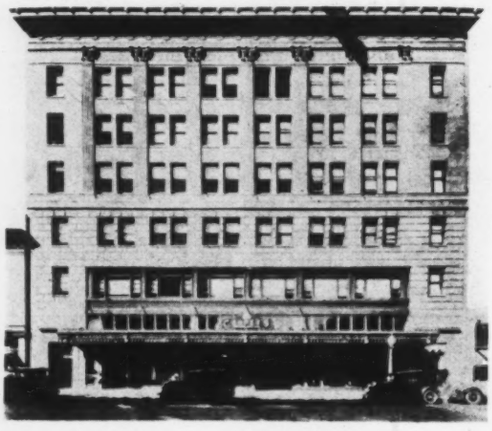
The plant recently installed replaces the former spray conditioning apparatus with a combination water precooling and direct expansion system of modern type. The problems involved demonstrate the ingenuity required in the special application of air conditioning to existing buildings.

Design Conditions

The section of California in which Fresno is located has an exceedingly dry climate and the outside design of the system was based on a dry bulb temperature of 100 F with a wet bulb of 70 F (relative humidity of 20 per cent) while the inside design condition was 80 F dry bulb and 65½ F wet bulb (45 per cent relative humidity).

Since these conditions indicate that no moisture tonnage problem was involved—that is, that the moisture in the outside air did not require additional refrigeration capacity for dehumidifying—the engineers had only to decide between running return ducts to a mixing chamber, or ventilating entirely with precooled outside air, in which case no return ducts would be required. The latter method was finally chosen and the total tonnage requirement divided almost equally between the water precooling refrigeration and the "Freon-12" direct expansion refrigeration. The unique feature is that 100 per cent outside air is cooled and circulated, and no air is recirculated.

Modernized with air conditioning



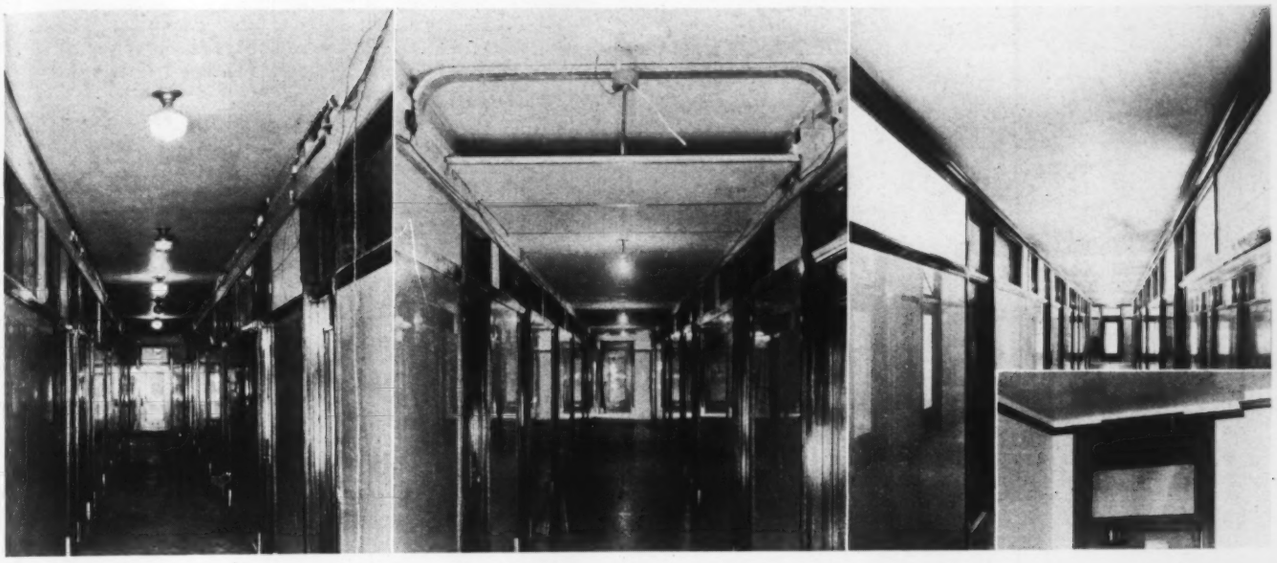
How Ducts Were Installed

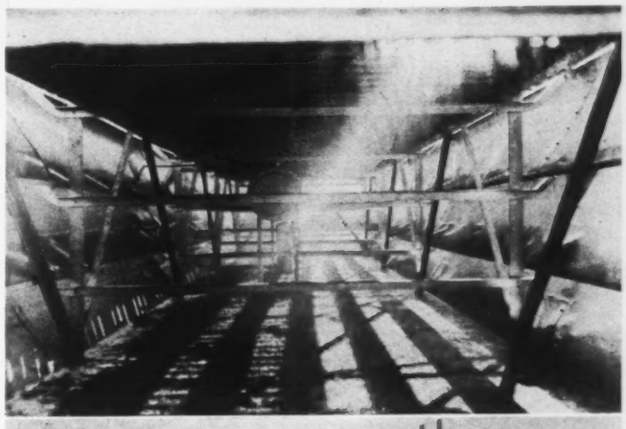
The development of an adequate installation for an existing office building presents widely different problems from those found in a new structure designed for air conditioning, and a primary consideration of the engineer is the location of ducts and their conformity to architectural features. The peculiarly dry climatic conditions previously mentioned and the limited space available made possible the construction of corridor ducts from non-metallic material. The simplified installation is indicated in the accompanying figures, one of which shows the corridor with slots cut through the space above the transoms for inlet grilles to the individual offices, while another shows the weatherboard under the slot openings forming, with the ceiling, a duct the full corridor width and approximately 9 in. deep. This duct was lined with asbestos and the lights were lowered to a new level after which the ducts were furred in and finished with plaster. It was also necessary to lower the wire moulding in the corridor.

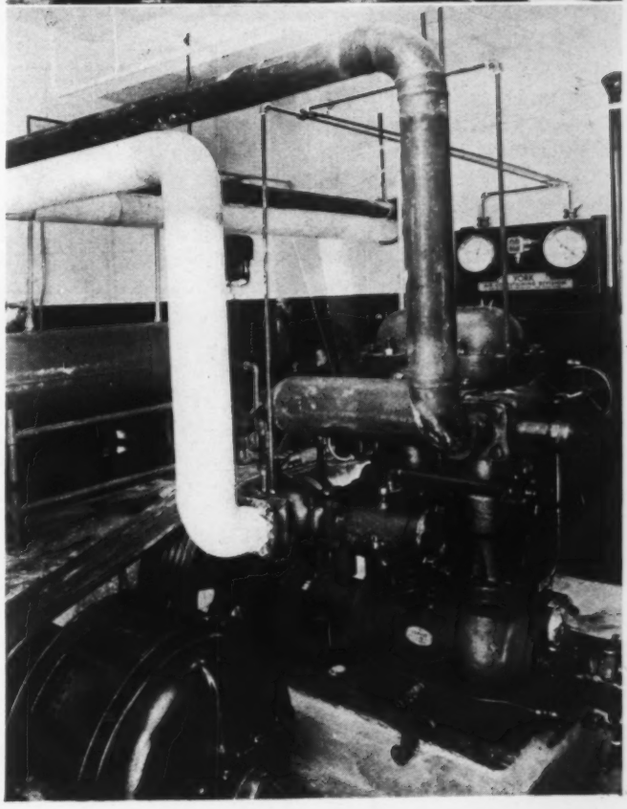
The location of the transoms in relation to the dropped ceiling in the corridors presented quite a problem, as the tops of the transoms were higher than the bottoms of the corridor ducts. To overcome this, all transoms had to be sent to a planing mill and 6 in. was cut off of the transom heights. It was then necessary to put in fill pieces above the transoms in which the supply grilles were located.

There is an advantage in horizontal corridor duct design over the vertical riser method in which a series of vertical duct drops are made throughout the building to distribute the air properly. Vertical risers take up valuable rentable area and most offices are rented on a square foot basis. Also, vertical risers do not permit flexibility in redesigning suites, taking out partitions, etc., for loft space, as in many cases the vertical ducts are right in the middle of the partitions that have to be moved. Corridor ducts, on the other hand, permit this flexibility and the building manager

*Sales Engineer, York Ice Machinery Corp.







Left to right, across top—First step in installing ducts—opening slots in walls for inlets . . . Duct partially in place forming false corridor ceiling . . . Completed installation, showing conformity of the job to the corridor . . . Inlet grille inserted inconspicuously in moulding above door; there is no return grille, as all outside air is supplied . . . *At right*—One of the condensers and receivers in space between pan and first deck of galvanized metal cooling tower . . . *At bottom*—Machine room and compressor

can eliminate or rearrange the partitions to suit himself without the necessity of changing air distribution from the ducts. Furthermore, entire floors can be shut off by closing the main floor dampers.

Each floor of the Brix Building is divided into two zones with volume regulation through dampers with gear controls. The distribution system circulates 40,000 cfm of air and, as mentioned, this volume is all outside air which has been precooled by passing through a series of water cooled coils and a bank of direct expansion evaporators.

Atmospheric Cooling Tower

An atmospheric cooling tower provides water for the coils by which the outside air introduced for ventilation is precooled, and in the space between the decks of the cooling tower the "Freon" condensers and receivers were situated. The supplementary cooling by mechanical refrigeration was facilitated by the installation of the direct expansion finned coils in a bank in the air washer chamber of the original air conditioning system and these were connected to a two cylinder reciprocating compressor driven by a 75 hp motor.

Applying air conditioning to an existing building taxes the ingenuity of the engineers and contractors, a prime consideration being the location of the ducts and their conformity to architectural features . . . . Here's how the job was done at the Brix Building, Fresno, California . . . . A feature of the installation is 100 per cent outside air with no recirculation

An air conditioned restaurant

Practical Standards for Air Conditioning Calculations

By W. S. Bodinus*

The Survey and General Procedure

THE first essential in the calculating of an air conditioning problem is to make a complete survey of the space to be conditioned. Overall dimensions should be made of the space showing all major structural details such as columns, beams, stair openings, windows, etc., and a cross section should show story heights, net ceiling height and clear height under beams. Windows should be spotted with sill height, window frame width and height and also space above window, since these details generally establish the location of supply and return air ducts. Large pipes, risers, sprinklers, and ceiling electric outlets should be located and spotted on the plan. Total number of people, electric lights and approximate number burning, utilities such as toasters, steam tables, coffee urns, gas burners, and other appliances should be listed as well as noted on the plan since there are occasions when much of this equipment is concentrated in one location which in turn necessitates supplying more air toward that particular location; or possibly it will afford a good location for the return air grille. Directions must be noted to provide a basis for determining the amount of infiltration as well as sun exposure. Tall adjoining buildings, shade trees, etc., should be observed and amount of shading noted.

After all of the physical considerations have been noted it is then advisable to approximate the size of equipment and look for possible equipment locations. Air conditioning apparatus may be situated within the air conditioned space, on the floor or at the ceiling or may be placed immediately outside with duct and piping extensions to the space. Water cooling and refrigerating equipment should preferably be situated outside the air conditioned space but as near to the air conditioning apparatus as possible to reduce initial cost and operating expense. If it is impossible to visualize the size of equipment, a return trip is necessary after the Btu estimate has been completed and the equipment selected.

Most air conditioning contractors or manufacturers provide their sales engineers with standard survey forms which contain a list of reminders, generally as follows: 1. Name of prospect. 2. Location. 3. Date. 4. Surveyed by. 5. Space used for. 6. Size—length, width and height. 7. Cubical contents. 8. Square feet of floor area. 9. Time space is occupied. 10. Size water supply, location, temperature and pressure. 11. Size drain and location. 12. Kind of electrical power and location. 13. Number of occupants. 14. Total lights and amount burning. 15. Horsepower of motors operating equipment in room. 16. Other heat generating apparatus. 17. Gas burning equipment. 18. Exhaust air systems and size of fan. 19. Supply air systems and size of fan. 20. Steam supply available, kind, pressure and location. 21. Suggested location of air conditioning equipment. 22. Space to bring in equipment. 23. Reinforcing required. 24. Location from freight depot. 25. Summer conditions to be maintained, dry bulb and relative humidity. 26. Winter conditions to be maintained, dry bulb and relative humidity. 27. Any product load. 28. Any moisture load. 29. Plastering, painting and redecorating required. 30. Cutting and patching. 31. Location for work shop on job. 32. Electric power cost. 33. Water cost. 34. Owner of building. 35. Length of lease. 36. Does landlord agree to installation? 37. Straight time or overtime.

*Engineer, Carrier Corp.

Part 6 of a series. Part 1 was published in May, pp. 281-284; Part 2 in June, pp. 367-368; Part 3 in July, pp. 415-417; Part 4 in August, pp. 488-491; and Part 5 in September, pp. 553-554.

Heating·Piping
and Air Conditioning

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

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CONTENTS • OCTOBER, 1937

Application of Air Conditioning to the Treatment of Disease, by C. P. Yaglou..... 635
Proper Air Conditions for the Manufacturing of Confections, by A. E. Stacey, Jr..... 640
Heating, Ventilating and Air Conditioning Courses 643
The Inspiration of Society Membership..... 646
Nominations for 1938..... 647
Nominees for A. S. H. V. E. Officers in 1938... 648
Council Members Nominated for Three-Year Term 649
A. S. H. V. E. Research—A Page of News Notes and Comment, by Brewster S. Beach..... 651
Correlating Thermal Research..... 652
New York Will Entertain A. S. H. V. E. at 44th Annual Meeting 653
News of Local Chapters..... 654
Candidates for Membership..... 656
Candidates Elected 657

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Application of Air Conditioning to the Treatment of Disease

By C. P. Yaglou* (*MEMBER*), Boston, Mass.

IN the past few years air conditioning has made considerable progress as an adjunct in the treatment of various diseases. Among the important applications are those in operating rooms, nurseries for premature infants, maternity and delivery rooms, children's wards, clinics for arthritic patients, in heat therapy, oxygen therapy, X-ray rooms, and in the control of allergic disorders.

Air Conditioning Operating Rooms

The most wide application of air conditioning in hospitals is that in operating rooms. Complete air conditioning of operating wards is not only desirable but often necessary for reducing the risk of explosion of modern anesthetic gases in dry winter atmospheres, and for the protection of the patient and operating personnel against excessive summer heat.

Humidification and Ventilation for Reducing Explosion Hazard

Explosion hazards in operating rooms have begun with the introduction of modern anesthetic gases and anesthesia apparatus. Ether administered by the old drop method is still regarded as comparatively safe; but when mixed with pure oxygen or with nitrous oxide in certain concentrations (see in Table 1), the explosion hazard may be as great as with ethylene-oxygen mixtures.

During the course of ethylene anesthesia the mixture, usually 80 per cent ethylene and 20 per cent oxygen, is so rich that the danger of explosion is slight, confined to an area in the immediate vicinity of the face mask, where leakage of ethylene into the air may accumulate to the lower explosion concentration (see Table 1). The most dangerous period is at the end of the operation when the patient's lungs and apparatus are customarily *washed out* with oxygen with or without the addition of carbon dioxide. Even when this procedure is omitted, it is difficult in practice to avoid dilution of the anesthetic gas with air during the normal course of breathing following the administration of anesthesia. In either case the mixture would pass through the explosion range and extraordinary precaution is necessary for the safety of the patient and operating personnel.

Copious ventilation, from 6 to 12 air changes per hour, is necessary to preclude accumulation of explosive mixtures and to reduce the concentration of anesthetics to below the physiologic threshold so that the surgeon and his personnel will not be affected.

The most important cause of accidents is probably static sparks which may result from accumulation of frictional charges on the rubber surfaces of the anesthesia apparatus, on woolen blankets, and on the bodies of the operators as they walk on insulated floors, when the humidity is quite low. Grounding the various parts of the anesthesia apparatus is not entirely effective, so long as rubber remains in use in the conventional equipment.

To prevent accumulation of static charges within the apparatus or on persons coming near to it, the measures proposed[1] are humidification of air to between 55 and 60 per cent relative humidity, grounding the apparatus and operating table, and using conducting floors and shoes so that the operating staff and attendants will be always grounded as they move about.

Table 1—Approximate Limits of Inflammability of Ethylene and Ether[a]

Mixed With	Ethylene		Ether	
	Lower Limit Per Cent	Upper Limit Per Cent	Lower Limit Per Cent	Upper Limit Per Cent
Air	3.0	30±	1.7	50—
Oxygen	3.0	80—	1.7	40±
Nitrous Oxide			3.8	26±

[a]Limits of Inflammability of Gases and Vapors, H. F. Coward and G. W. Jones, *U. S. Deparment of Commerce*, Bulletin No. 279, 1931.

Operating Room Conditions

Under the influence of anesthesia a patient is at a very low ebb. All anesthetics, as a rule, produce dilation of the vessels in the skin and much sweating, particularly in the case of ether anesthesia. The loss of body heat is increased considerably, while the general metabolism may be depressed. The organism loses ability to regulate its own body temperature and becomes unusually sensitive to chilling and post-operative complications. In order to maintain a normal body temperature, a high air temperature is necessary, as high as 90 F or higher in the case of ether anesthesia, judging from experiments on animals[2].

Such high temperatures are obviously uncomfortable for the operating personnel, and in order to alleviate the condition the room temperature is usually kept between 72 and 80 F in cold weather with the patient carefully guarded with blankets and hot water bottles during and for some time after the operation.

Post-Operative Heat Stroke: It would seem that surgeons have learned to fear so much the occurrence of post-operative pneumonia and shock that even in hot

*Assistant Professor, Industrial Hygiene, Harvard School of Public Health.

[1]The Hazard of Explosion of Anesthetics, by Y. Hendersen. Report of the Committee on Anesthesia (*Journal American Medical Association*, 94:1491, 1930).

[2]Heat Regulation and Water Exchange. The Influence of Ether in Dogs, by H. G. Barbour and W. Bourne (*American Journal Physiology*, 67:399, 1924).

summer weather patients are sometimes needlessly *bundled up* with detrimental consequences.

In 1916 several deaths were reported[3] of heat stroke following surgical operations, and a number of cases suffering from a mild isolation, often recognized as post-operative reaction or shock. From these observations it was concluded that all operating room activities should cease during summer heat waves with the exception of urgent operations, when every effort should be made to keep the patient cool and comfortable.

In cases of exophthalmic goitre, one investigator[4] warns most emphatically against the performance of operations in extremely warm weather, for under such conditions the risk in spite of all precautions (prior to the introduction of summer cooling in operating rooms) is too great. An analysis of several cases over a 10-year period shows a striking rise of post-operative deaths in June, July, and August, resulting unexpectedly from extreme post-operative reaction passing onto acute hyperthyroidism.

More recently four cases were reported[5] of post-operative heat stroke admitted 24 hours preceding operation and sheltered from direct sun rays. All four were not ill and apparently were good risks. There occurred, however, at the time of operation and for several days preceding it, a heat wave with a moderately high temperature, a high relative humidity, and no wind. In addition to warm weather, excessive loss of body fluids is believed to have been a factor in the production of heat stroke in those four cases.

Aside from the possibility of post-operative heat stroke in warm and sultry weather, the surgeon is also concerned with the lowered recuperative power of the patients, and with his own discomfort as well as the discomfort of his team, which impairs the efficiency of the technic to the disadvantage of the patient.

In view of this experience it is customary to defer major operations as much as possible until the passing of heat waves, in hospitals not equipped with cooling facilities. But there are exceptional cases, like acute appendicitis for instance, which sometimes come with summer heat waves, and develop dangerously unless promptly operated upon. Complete air conditioning of operating rooms would therefore seem to be a necessity in many sections of the United States.

Satisfactory Air Conditions: Although the comfortable air conditions for the operatives are not identical with those of the patient, a compromise is as a rule not difficult; with a relative humidity of 55 to 60 per cent, a temperature of 80 F in warm weather and between 72 and 75 F in cold weather will probably prove satisfactory. Additional heat may be furnished to the patient locally or by suitable covering according to body temperature in individual cases.

Central station air conditioning plants and individual unit air conditioners proved satisfactory in operating rooms when producing between 8 and 15 air changes per hour of filtered and properly humidified air, with full provision for summer cooling and dehumidification and without recirculation during the course of anesthesia. A separate exhaust fan system is as a rule necessary in order to confine and remove the gases and odors. Double windows are desirable and often necessary to prevent condensation and frosting on the glass in cold weather and to minimize drafts. The high air flow of 8 to 15 air changes in operating rooms is desirable for three reasons: (*a*) to reduce the concentration of the anesthetic to well below the physiologic threshold in the vicinity of the operating personnel, (*b*) to remove excessive amounts of heat and sometimes moisture from sterilizing equipment if inside the operating room, from the powerful surgical lights, solar heat, and from the bodies of the operatives, and (*c*) to provide extra capacity for quickly preparing the room for emergency operations. Much can be gained by careful insulation of sterilizing equipment and by thorough exhaust ventilation of sterilizing rooms adjoining the operating rooms.

It is generally believed that in addition to operating rooms, an adjoining ward should also be conditioned to provide for the treatment of post-operative fever. Such a post-operative ward may also prove valuable in treating patients with heat stroke, fevers, summer diarrhea and other cases affected by high temperature, when the room is not used for anything else.

Sterilization of Air in Operating Rooms: Of considerable significance to operating rooms and contagious wards is the use of ultra-violet radiation for sterilizing the air.[6] Results reported[7] would seem to indicate that the post-operative temperature rise of patients during the first few days is in most instances caused more by bacterial contamination of the operative wound than by the absorption of blood and traumatized tissues. Operating room infections, which were quite frequent before the installation of special ultra-violet lamps, have practically disappeared.

Air Conditioning Nurseries for Premature Infants

One of the most important requirements in the care of premature infants is the stabilization of body temperature. This is necessary because their heat regulating system is not fully developed: the metabolism is low and the infants generally exhibit marked inability to maintain a normal body temperature by their own efforts. The resistance to infection is low and the mortality rate, very high.

Air Conditioning Requirements

The optimum air conditions for the growth and development of these infants were determined by extensive research at the Infants Hospital, Boston, Mass.,[8] using four valid criteria, namely, stability of body temperature, gain in weight, incidence of digestive syndromes, and mortality. Wide variations were found in individual requirements for temperatures from 72 to 100 F, according to the constitutional state of the infants and body weights. The optimum relative humidity was about 65 per cent, and the air movement less than 20 fpm.

A single nursery conditioned to 77 F temperature and 65 per cent relative humidity was found to satisfactorily

[3] *Post-operative Heat Stroke*, by A. V. Moschcowitz (*Surg. Gyn. Obst.*, 23:443, 1916).

[4] The Effect of Heat Upon Operations for Exophthalmic Goitre, by A. J. Walton (*Brit. Med. Journal*, 1:1045, 1923).

[5] Postoperative Heatstroke, by T. M. Martin (*Journal Missouri Med. Ass'n*, July, 1928. *Abst. Anesth. and Analges*, 8:23, 1929).

[6] Air Borne Infection and Sanitary Air Control, by W. F. Wells (*Journal Ind. Hyg.*, 17:253, 1925).

[7] Sterilization of the Air in the Operating Room by Special Bactericidal Radiant Energy, by Deryl Hart (*Journal Thoracic Surgery*, 6:45, 1936).

[8] The Premature Infant: A Study of the Effects of Atmospheric Conditions on Growth and on Developmeent, by K. D. Blackfan, C. P. Yaglou and K. McKenzie (*Amer. Journal Disease of Children*, 4[illegible]1175, 1933).

fulfill the requirements of the majority of premature infants. Additional heat for weak or debilitated infants may be furnished in the cribs or by means of electric incubators placed inside the conditioned nursery and the temperature adjusted according to individual requirements. In this way multiplicity of chambers and of air conditioning apparatus is obviated; the infants in the heated beds derive the benefit of breathing cool humid air, and the nurses and doctors need not expose themselves to extreme conditions.

Importance of Humidity: Although external heat is an important factor in the maintenance of normal body temperature, humidity appears to be of equal or greater importance. When the premature nurseries at the Infants Hospital were kept at relative humidity between 25 and 50 per cent for two weeks or longer, the body temperature became unstable, gains in weight diminished, the incidence of gastro-intestinal disturbances increased, and the mortality rose. On the other hand, continuous exposure to air conditions with 55 to 65 per cent relative humidity gave satisfactory results over a period of years.

Maximum gain in body weight occurred in the conditioned nurseries under high humidity (55 to 65 per cent) in infants weighing less than 5 lb. The gains were less under low humidity (25 to 50 per cent) in the same nurseries, and in the old nurseries prior to the installation of air conditioning apparatus.

The incidence and severity of digestive syndromes, with diarrhea, persistent vomiting, diminishing gains or loss of body weight, and other symptoms, were generally from two to three times as high under low than under high humidity.

Finally, the mortality of premature infants was found to be greatly affected by humidity. In Table 2 is given the net mortality according to the humidity in which the derangement of body function began. In the old nurseries, prior to the installation of the air conditioning system, the death rate from acute and chronic infections was 26.5 per cent as compared with 9.7 per cent in the conditioned nurseries under low humidity and 0.0 per cent under high humidity.

Summarizing the conclusions of these studies, the best chances for life in premature infants are created by maintaining a relative humidity of 65 per cent in the nursery and by providing a uniform environmental temperature just sufficiently high to keep the body temperature within normal limits. Medical and nursing care are, of course, factors of equal and sometimes of greater, importance.

Air Conditioning Equipment: Most of the installations now in use are of the central station type providing for filtration, for humidification and heating in cold weather, and for cooling and dehumidification in hot weather. A high ventilation rate, between 15 and 25 air changes, is desirable to remove odors and maintain uniformity of temperatures in extremes of weather. Recirculation is not used extensively in these wards owing to odors and the possibility of infection.

Table 2—Net Mortality of Premature Infants According to Humidity[a]

Infants Hospital, Boston, Mass.

Cause of Death	Unconditioned Nurseries (1923-1925)	Conditioned Nurseries (1926-1929)	
		Relative Humidity	
	Natural Humidity	25-49 Per Cent	50-75 Per Cent
	Per Cent Mortality	Per Cent Mortality	Per Cent Mortality
Acute and chronic infections	26.5	9.7	0.0
Congenital deformities	1.2	0.0	0.7
Unclassified	1.2	4.8	0.0
All causes	28.9	14.5	0.7

[a]Excluding cases with multiple congenital anomalies incompatible with life, and also deaths occurring within 48 hours after admission to the hospital.

Air Conditioning in Fever Therapy

Underlying Principle

Artificial production of fever in man is an imitation of nature's way of overcoming invading pathogenic organisms. The action may be direct and specific by obliteration or destruction of the invading organism within the safe limit of human fever temperature; or an indirect one in case of heat resistant organisms, through general mobilization of the defensive mechanisms of the body, by means of which the activity of pathogenic bacteria and their toxins may be retarded or neutralized.

The diseases reported to respond favorably to artificial fever are: gonorrhea, neurosyphilis, chorea, asthma, peripheral vascular diseases, occular gonorrhea and syphilis. There are a number of other conditions in which the usefulness of artificial fever is not yet settled. The most striking results are seen in gonorrhea in which various strains of organism can be killed by artificial fever within the limits of tolerance of man.

Equipment for the Production of Systemic Fever

Various means have been tried for producing artificial fever, including injections of various crystalloid or colloid substances; a number of physical methods, such as hot baths, radiant heat, diathermy, radiothermy, and, in the last few years, an air conditioned chamber.

The relative advantages and disadvantages of these various methods were discussed in recent papers.[9] Although comparable clinical results are possible with most of these methods, the air conditioned cabinet appears to be the safest and most effective method from all points of view. Under certain conditions a combination of systemic fever and additional local heating by diathermy or other means is claimed to yield better results than systemic fever and additional local heating by diathermy or time of the organism and rendering the treatment less trying to both patient and attendants.[10]

The air conditioned chamber[11] consists of an insulated cabinet approximately 6 ft long, 3 ft wide, and 2½ ft high, containing in a small rear compartment, electric air heaters, a water pan for humidification, a centrifugal fan, and controls. The nude patient lies on an air mattress inside the front compartment with his head protruding outside the front end through a rubber collar. Warmed air at 130 to 150 F and 30 to 50 per cent relative humid-

[9]Fever Therapy for Gonococcic Infections, by A. U. Desjardins, L. G. Stuhler and W. C. Popp (*Journal American Medical Association*, 106:690, 1936).
Artificial Fever Therapy as a Therapeutic Agent, by H. P. Doub (*Radiol.*, 25:360, 1935).

[10]The Treatment of Gonorrheal Arthritis by Means of Systemic and Additional Focal Heating, by W. Bierman and C. Levenson (*American Journal Medical Science*, 191:55, 1936).

[11]Artificial Fever Therapy of Syphilis, by W. M. Simpson (*Journal American Medical Association*, 105:2132, 1935).

ity is blown upon the body of the patient, and the rectal temperature rises to 105 F usually in from 40 to 60 min. The heat is then turned low and adjusted so as to maintain the desired body temperature in each individual case.

Recently, an improved heat cabinet was described[12] in which saturated air between 100 and 120 F in temperature is used for elevating the patient's body temperature. This gives a rapid rise of body temperature with a relatively low air temperature; it eliminates skin burns, and the room in which the heat box is located is not overheated unduly.

Extensive research is now in progress to determine the usefulness and limitations of fever therapy on a wide variety of pathogenic conditions. While this form of therapy is rapidly gaining wide recognition, its application, according to the *American Medical Association*, "should be strictly a hospital procedure surrounded with the safeguards commonly employed in a major operation and under the direction of skilled physicians."

The Control of Allergic Disorders

Causes and Symptoms of Hay Fever and Asthma

Although there is some division of opinion over the ultimate cause of allergy, the prevailing belief is that it is due to an inherited or acquired hypersensitiveness to foreign or pollen proteins in certain individuals who react abnormally to the offending substance. The reaction may be induced by inhalation, eating, or absorption of the allergens through the skin. The clinical manifestations are hay fever, asthma, eczema, hives, contact dermatitis, etc.

The respiratory tract is probably the most usual site of allergic manifestations, the so-called hay fevers and asthma. In hay fevers, the nose and eyes are red and itchy, and there is considerable discharge. Nasal obstruction is the most common and most distressing symptom. The severity of the symptoms varies widely from day to day depending chiefly on the amount of pollen in the air.

Seasonal asthma comes in attacks. The most popular theory concerning the mechanism of action is that the offending substance irritates the nerve endings in mucous membranes of the respiratory tract, causing spasmodic contraction of the small bronchioles of the lungs, which interferes with breathing, particularly with expiration. Non-seasonal allergic disturbances are sometimes attributed to house or street dusts, fungi, odors and irritating gases, and heat or cold, particularly sudden temperature changes. It is often stated in the literature that heat regulation in asthmatic individuals is likely to be unstable, with a tendency to subnormal body temperature. Many allergic cases who are apparently well, develop their attacks when cold weather appears, or upon changing from warm to cool outdoor air.

Air Conditioning Apparatus

In recent years considerable effort has been directed toward the elimination of the principal cause of allergy from the air of enclosures by filtration or other air conditioning processes capable of removing pollens, in the hope of providing relief to individuals who failed to respond to medical treatment (desensitization or immunization).

Paper or cloth filters, mounted in inexpensive window or floor units, proved quite satisfactory in removing all but traces of pollen. Allergens may also be removed by passing the air through a water spray, or over cooling coils kept at a temperature low enough to cause condensation of atmospheric moisture on the surface of the coils.

Although the chief remedial factor in the treatment by conditioned air is the filtration of pollen, a certain amount of cooling and dehumidification appear to be desirable. A comfortable temperature between 75 and 82 F in warm weather and a relative humidity well below 50 per cent proved satisfactory.[13] Direct drafts, overcooling or overheating are apt to initiate or aggravate the symptoms.

Usefulness and Limitations of Air Conditioning Methods

The results obtained with air filtration or other air conditioning processes in the control of allergic conditions are fairly comparable to those obtained by desensitization treatment so long as the patients remain in the pollen free atmosphere. But while specific desensitization is preventive and in a few instances curative for all practical purposes, filtration gives only temporary relief. With rare exceptions, the symptoms recur on exposure to pollen laden air. Moreover the usefulness of air conditioning methods is limited because all cases are not caused by air borne substances. Cases of bacterial asthma do not respond at all to the treatment with filtered air.

Despite these limitations, air conditioning methods possess definite advantages in the simplicity of treatment, convenience, and under certain conditions almost immediate relief. Hay fever cases are usually relieved of most of their symptoms within an hour or so after exposure to properly filtered air. In pollen asthma cases relief comes more slowly, usually after an exposure of from 1 to 12 days depending upon the severity of asthma.

A pollen free atmosphere is especially valuable for patients in whom desensitization has given little or no relief, and in instances in which desensitization is not advisable owing to intercurrent illness. On the whole, conditioning methods are considered to be a valuable adjunct in medical diagnosis and treatment of allergic disorders.

Air Conditioning in Oxygen Therapy

Oxygen therapy is the principal measure employed for preventing and relieving the distressing symptoms of anoxemia, which is a deficiency in the oxygen content of the blood. Some of the more important conditions in which oxygen treatment is believed to be beneficial are pneumonias, anemia, heart affections, post-operative pulmonary disturbances, certain mental disturbances, asphyxia, asthma and atelectasis in new-born infants.

The necessity of air conditioning in oxygen therapy arises from the fact that oxygen is too expensive a gas to waste in the ventilation of oxygen tents and oxygen chambers. The oxygen rich atmosphere in these enclosures is therefore reconditioned in a closed circuit by removal of excess heat, moisture, and carbon dioxide given off from the occupants.

[12]Fever Therapy Induced by Conditioned Air, by F. C. Houghten, M. B. Ferderber and Carl Gutberlet (A.S.H.V.E. Journal Section, *Heating, Piping and Air Conditioning*, February, 1937).

[13]The Effect of Low Relative Humidity at Constant Temperature on Pollen Asthma, by B. Z. Rappaport, T. Nelson and W. H. Welker (*Journal Allergy*, 6:111, 1935).

Oxygen Tents: In oxygen tents the air enriched with oxygen is usually circulated by means of a small motor blower which sends the air over soda lime to remove carbon dioxide and then over ice to remove excess heat and moisture. In an inadequately cooled oxygen tent, high temperatures and humidities are inevitable, increasing the discomfort of the patient and imposing an added strain on an already overburdened heart. Oxygen therapy under such conditions may do more harm than good. An ice melting rate of about 10 lb per hour gives satisfactory results in patients with fever in a medium size tent.

Oxygen Chambers: The conventional oxygen chamber is an air-tight sheet metal enclosure of fire proof construction, large enough to accommodate one or two patients. Trap doors or curtains are provided for the personnel, food and service to avoid loss of oxygen. Glass windows in the ceiling and walls admit light from electric fixtures outside the chamber.

The air conditioning system may be of the gravity type, or of the fan type using mechanical refrigeration or silica gel for drying the air. The gravity system includes a bank of brine coils controlled thermostatically, which dehumidify and cool the air. The cool air falls over trays at the bottom of the coils, containing soda lime to remove the carbon dioxide given off by the occupants. A heater at the base of the opposite wall warms the air to the desired temperature. Ordinary industrial oxygen is introduced from storage tanks outside the chamber and the concentration is regulated according to the prescription of the physician. The only change of air in the chamber is that taking place by leakage through trap doors.

The chief objections to the gravity circulation system are stratification of cold air near the floor and accumulation of odors, which may require the use of activated charcoal or an excess of oxygen for deliberate aeriation.

The fan circulation systems include compact extended surface coolers, heaters, and sometimes silica gel beds installed outside the chamber for the removal of moisture. A spray dehumidifier is not suitable for this purpose because it is often desired to cool the air below 32 F in order to obtain low relative humidities.

The temperature and humidity requirements in oxygen therapy depend primarily upon the physical condition of the patient, and secondarily upon the type of disease. In pneumonias, the range of satisfactory conditions is placed between 60 and 75 F with 20 to 50 per cent relative humidity, depending on the condition of the patient.

Oxygen chambers are unquestionably more comfortable than oxygen tents. The patients receive unhampered medical and nursing care, and the oxygen concentration, the temperature and humidity can be adequately controlled at any desired level. The chief disadvantage is high initial and operating costs in comparison with oxygen tents or with the nasal catheter method of oxygen administration. The nasal catheter method is the simplest and most inexpensive of all but it may cause considerable discomfort to the patient and it is not satisfactory for continuous administration and in restless or delirious patients. Moreover, oxygen concentrations greater than 40 per cent in the inspired air are difficult to obtain.

The chamber method is of value in large hospitals and for research and experimental purposes, but for routine oxygen therapy alone it may prove a liability rather than an asset in many hospitals.

General Hospital Air Conditioning

Complete conditioning of large hospitals involves a capital investment, depreciation and running expense which may not be justified.

In clean and quiet districts, the requirements of almost all general and private wards during the cool season of the year can be satisfactorily fulfilled by the use of rational heating in conjunction with window air supply and gravity or mechanical exhaust. Insulation against heat and sound is much more important than humidification in winter; it will also help considerably in keeping the building cool in warm weather. Excessive outside noise and dust may require the use of silencers and air filters in the window openings.

Cooling and dehumidification in warm weather are important. In new hospitals particularly, the desirability of cooling certain sections of the building should be given serious consideration. Financial reasons may preclude the cooling of the entire hospital, but the needs of the average hospital can be met by the use of built-in room coolers and a few portable units which can be wheeled from ward to ward when needed.

In the North and certain sections of the Pacific Coast, cooling is needed on but a few days during summer, while in the South, built-in room coolers can be used to advantage from May to October, and in tropical climates almost continuously throughout the year. Objectionable noise is an important drawback to the use of self-contained units, but the difficulty is gradually being overcome by improvements in design.

Aside from comfort and recuperative power of the patients, cooling is of great assistance in the treatment of pyrexias in the newborn and in post-operative cases, in enteric disorders, fevers, heat stroke, heart failure, and a variety of other ailments which often accompany summer heat waves.

Considerable research is now in progress on the influence of air conditioning upon a wide variety of diseases such as pneumonias, upper respiratory diseases, tuberculosis, arthritis, nervous instability, hyperthyroidism, essential hypertension, skin diseases, vascular disorders, and others. The field is a fruitful one having many possibilities.

Solid Fuel Meeting Report

Bound copies of the proceedings for the first annual conference of the *Combustion Appliance Makers Association* held in England on March 16, 1937 are available through the Secretary at 54 Victoria St., London, S.W.1. Titles of the papers presented at this meeting were Applied Combustion Research, The Domestic Market for Solid Fuel, and Recent Advances in Mechanical Firing.

Proper Air Conditions for the Manufacturing of Confections

By A. E. Stacey, Jr.* (*MEMBER*), New York, N. Y.

CANDIES and confections are now being economically manufactured under accurate control of temperature, humidity and air motion to produce products of the highest quality with a brilliance of appearance which is intended to appeal particularly, to the customer. The design of machines and improvements in the processing of a product are changing rapidly thus making it necessary in many instances to alter the air conditions in order to meet the new requirements of increased machine speed, or process change.

General Requirements

In general, air conditioning apparatus for confection manufacture must be capable of absorbing heat from various sources such as machinery power, electric lights, people, sunlight and chemical reaction of the process. The equipment must be capable of conditioning air to any desired temperature or moisture content and of providing ample air supply at all times. Refrigeration may or may not be required depending upon natural conditions, the required relative humidity and the maximum permissible temperature. Washing, purifying and recirculating the air to be introduced to an enclosure may be desirable. Good distribution is essential for the control of air motion and for the prevention of uneven conditions. Accurate and reliable automatic control of humidity or temperature, or both, is vital in most cases.

Desirable relative humidity during the manufacture of candy depends upon the product and the nature of the process. As far as the behavior of the material itself in its desired final condition is concerned, each material and process presents a different problem. Similarly, the most desirable temperature for the processing of different materials may range between wide limits. Extremes in either relative humidity or temperature require relatively expensive equipment for maintaining these conditions automatically. In departments where people are working, their health, comfort and productive efficiency must be considered and often a compromise between the optimum conditions for processing and those required for the comfort of the worker is desirable.

Classification of Problems

Air conditioning is applied to the manufacture of confections in order to control the rate of crystallization, the regain or equilibrium moisture, or other physical condition of the product.

The rate of cooling of a saturated solution determines the size of crystals formed. Both temperature and relative humidity are of importance as one controls the rate of cooling, while the other through evaporation changes the density of the solution. Only by balancing the temperature, relative humidity and volume of air to the density of the sugar solution can the proper rate of crystallization be obtained and a perfect coating on the product be assured.

Where the physical properties of a product affect its values such as in the candy industry, the question of percentage of moisture is of special importance. With increase in moisture content some materials become softer and more pliable. Frequently, moisture deficiencies result in loss of revenue to the seller and loss of desirable quality to the buyer.

Manufacturing economy requires that moisture content be maintained at a percentage favorable to rapid and satisfactory manipulation and to a minimum loss of material. A uniform condition is desirable in order that high speed machinery may be adjusted permanently to the desired production, resulting in a minimum loss from delays and spoilage of material.

Starch Room

One of the important departments in the manufacture of candies is the starch room which should be conditioned so as to maintain a constant amount of moisture in the starch. This is a problem of regain and, consequently the relative humidity is of the most importance. The proper amount of equilibrium moisture in the starch generally corresponds to the maintenance of conditions at a relative humidity of 50 per cent. Under these conditions, the starch is neither too dry to adhere to the bon-bon centers, nor too moist to adversely affect the conditions of the centers.

Temperature conditions in the starch room are varied depending upon the amount of glucose used in the process. For pure cane sugar, air conditions are maintained at 85 F dry-bulb and 50 per cent relative humidity, but if glucose is substituted for the cane sugar, the temperature should be reduced to 75 F dry-bulb with the same relative humidity. Lower temperatures are desirable for the glucose due to the fact that it is more hygroscopic and more susceptible to high temperature than the cane sugar solutions. The necessary reduction in moisture content of the air is made in this case by lowering the temperature instead of the relative humidity, because of the effect that lowered humidity would have upon the starch. Under these air conditions, the small bon-bon centers will harden in less than 3 hours, perhaps in one to two hours, while it may take 24 hours to harden the larger sizes.

In this department, a high circulation of air is beneficial since this is a problem of conditioning which is analogous

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to drying. To obtain uniformity of product every tray of starch should be subjected to the same conditions of air movement, as well as temperature and relative humidity.

In the manufacture of marshmallow work, the starch should be conditioned to a regain of 5 to 7 per cent so that neither a leathery skin will be produced on the marshmallow, nor an insufficient amount of moisture removed to prevent spoilage.

Manufacturing Hard Candy

Departments manufacturing hard candy should be air conditioned so as to obtain a brilliant finish in all seasons of the year. This type of candy is seriously affected by temperature and relative humidity. Best results are obtained at a temperature of 70 F dry-bulb and a relative humidity between 35 and 45 per cent. The proportion of cane sugar to glucose used determines the proper humidity for ideal results. The larger the percentage of cane sugar used in the mix the higher the relative humidity may be maintained in a work room without causing detrimental effects. From an operating and first cost standpoint, as high a relative humidity should be maintained as is consistent with the process.

Chocolate Bar Department

The chocolate bar department has a problem of not only cooling the chocolate but also of maintaining a sufficiently low dew point temperature in the room containing the cooler to prevent condensation forming in the chilled molds as they pass through to the discharge room. In the cooler a high circulation of chilled air must be maintained to give a quick set to the bar with a resulting high gloss finish. Air temperatures in most coolers have been found satisfactory when maintained between 35 and 45 F dry-bulb with a relative humidity of 80 per cent. However, judgment must be used in the selection of the proper temperatures as too rapid a cooling will cause checking and cracking.

The room in which the chocolate bars are discharged from the cooling box should be maintained at a temperature of 65 F dry-bulb and a relative humidity of 45 per cent. This condition will eliminate the danger of condensation forming on the bar, and thus preserve the high finish and coloring of the chocolate.

Enrobing Room

The necessity for air conditioning of the enrobing room where the chocolate coating is applied is to prevent condensation on the bon-bon centers which are at a temperature of approximately 65 F dry-bulb. The dew point of the air is of utmost importance, although the temperature may be within the limits allowable for manipulating the chocolate and should be governed somewhat by the effect on the workers in this department. A satisfactory condition in this room is about 61 F dry-bulb and 50 per cent relative humidity. If the temperature in the room is raised to 67 F dry-bulb which incidentally would be satisfactory from the standpoint of working the chocolate, the relative humidity should be decreased to 40 per cent which would result in the same dew point temperature.

Hand Dipping Room

The hand dipping room and the enrobing cooling room present practically the same problem, that is, to cool the chocolate coating in such a manner as to bring out a high lustre and insure a quality product. To accomplish this result, quick cooling of the coating is essential with a room temperature of 61 F dry-bulb and a relative humidity of 50 per cent.

The distribution system should be designed to cause a high air movement over the goods. In case a machine cooler is used, special attention should be given to the introduction of air to the equipment in order that the highest possible circulation of air is obtained over the product. In those manufacturing plants in which the chocolates are handled on trays in a truck, it is important to give special consideration to the room air circulation.

Coating Process

Plants employing coating kettles or pans find it very beneficial to employ the use of conditioned air for controlling the coatings applied in the kettles. The time of coating is lessened and the number of pieces with imperfections such as check cracks and rippling are reduced to a minimum. After the coating is completed the polishing and waxing may be performed immediately and the usual 24 hour seasoning period between coating and polishing may be entirely eliminated. In order to accomplish these results, it is essential that both the temperature and relative humidity of the air supplied to the kettles be under precise control. The method of introduction of air may cause a variation in the time of coating amounting to more than 50 per cent. Air conditioning cannot replace the skill of an experienced coating operator, but the combination of the two will produce a high quality coating in a short period of time.

Gum Production

When gum is dried in the manufacturing process, the moisture is absorbed by the starch. Under good conditions of air circulation, the moisture will be evaporated from the starch by the air at the same rate that the starch absorbs water from the gum, thus leaving the starch in approximately a constant condition of moisture content. Therefore, the rate of gum drying can be maintained at optimum conditions through the proper control of temperature and relative humidity in the drying room. Under favorable conditions the danger of sunken places in the gum is eliminated and the time of drying is greatly reduced without the use of high temperatures. The temperature in the dryer will be governed by the type of materials used in the gum and also the boil. For some applications 120 F dry-bulb has proven to be a satisfactory temperature.

Storage Rooms

It has been found that storage rooms for candy that has been packed should be maintained at 70 F dry-bulb with 40 per cent relative humidity to obtain the best results. Candy to be shipped during hot muggy weather should not be stored at too low a temperature unless the boxes are warmed before shipping in a room at approximately outdoor air temperature and having a sufficiently

low humidity to prevent condensation. Absolutely air tight containers will also prevent the occurrence of condensation.

Table 1—Summary of Desirable Air Conditions for the Manufacture and Storage of Confections

Department	Dry-Bulb Temperature Deg F	Relative Humidity Per Cent	Dew Point Deg F
Starch Room—Cream Centers Cane	85	50	64
Starch Room—Cream Centers High Glucose	75	50	55
Hard Candy	70	35–45	41–47
Chocolate Bar Cooling	45	80	39
Chocolate Bar Discharge Room	65	45	43
Enrobing Room	61	50	42
Hand Dipping Room	61	50	42
Gum Work Drying	120–140	.....	.....
Candy Storage	70	40	44
Nut Storage	30–32	75–80	24–27

For the storage of nuts it has been recommended[1] that a temperature of 30 to 32 F and a relative humidity of 75 to 80 per cent be maintained.

Under these conditions there will be no mold growth and the oils will not become rancid. The humidity is sufficiently high to prevent the nuts from drying out, but not too high to cause the propagation of mold. Insect eggs are also dormant at this temperature.

Selection of Equipment

Requirements of the several departments in a candy plant which must be fulfilled by an air conditioning system are summarized in Table 1. From an inspection of these data it will be noted that in almost every case it is necessary to control both the temperature and the relative humidity. However, the relative importance between temperature and humidity may vary for different departments, as for example, in that process which involves the cooling of chocolate bars. In this case the temperature is important and must be under control, but the relative humidity is of minor importance and may vary through quite a wide range without any serious difficulty. In the starch room, the opposite is the case and the success with which the process is performed depends on the moisture content of the starch which is directly dependent on the relative humidity of the room. The temperature in this case needs only to be maintained so as not to exceed a maximum value. In the other confection departments both temperature and relative humidity are equally important. The temperature conditions as cited present a basis on which to select air conditioning apparatus.

In fulfilling the requirements of air conditioning for a candy plant the equipment selected must equate the heat and moisture content of the air supplied to the heat and moisture gain or loss from all sources in the plant so as to maintain the necessary temperature and relative humidity. Air conditioning equipment should be selected which will accomplish these various functions. There must be some method of heating the air as well as cooling it. In some departments it will be necessary to humidify and in others dehumidification is necessary so as to maintain the same conditions throughout the year. In order to accomplish these results there must be a controllable humidifier or dehumidifier as the situation demands. Accompanying this equipment will be needed a method of refrigeration and this may be of several types selected to best fulfill demands of the location and plant conditions with the greatest economy.

In selecting air conditioning equipment for a candy plant, it is important to consider the amount of sugar dust and starch particles in the air and their effect upon the equipment. Many of the available heating and cooling coils are of the fin or plate type, which produce a partial filtering of the air. This is especially true of cooling coils which are wetted by the moisture condensed from the air on the fin or plate surfaces. A very unsanitary condition will result unless thorough filtering of the air is accomplished before the air comes in contact with the coils or unless a spray of water is used in sufficient quantity to keep them well cleaned. Spray type dehumidifiers are not subject to this difficulty, as the large amount of water in circulation through the sprays is sufficient to maintain the sugar solution at a very low concentration. Spray type dehumidifiers also remove all mold spores and wild yeast from the air. In nearly every department, the close control of relative humidity is one of the basic needs for air conditioning equipment. The spray type equipment lends itself to a simple and accurate dew point control which is accomplished by varying the temperature of the spray water with the load.

There is an economic problem involved in the selection of a central or unit type system. The small air conditioning equipment of the unit type, employing direct expansion refrigeration in coils, is at this time lower in cost than a spray type system. The capital investment for air conditioning is proportionately large in a small plant and should be kept at a minimum. Such variations in relative humidity as might occur with the unit system, even though affecting the finish and quality of the candy to some degree, might well be acceptable in some cases. However, in most cases, it pays well to control the conditions of the temperature and relative humidity in a candy plant at optimum conditions at all times and the air conditioning equipment which will accomplish this is a good investment.

[1]The Commercial Storage of Fruits, Vegetables and Florist Stocks by Dean H. Rose, R. C. Wright and T. M. Whitman, U. S. Department of Agriculture, Bulletin No. 278.

Domestic Gas Burner Design

The effect of variations in the depth of metal through which the ports are drilled on the limits of operation of a domestic gas burner are outlined in a research paper by John H. Eiseman and Francis A. Smith. Some improvement in the operation of burners may be expected when using ports ¼ in. deep instead of less, but little is to be gained by making them deeper than ¼ in. Adverse effects of turbulence may be avoided by increasing the cross-section of the burner casting to a point where velocity flow will be less than the critical velocity. Otherwise ports smaller than No. 28 or deeper than ½ in. are required to suppress the turbulence produced in a burner. The test data were obtained with two gases of different composition and with four different port sizes.

Detailed reference to this study may be made through the *Journal of Research* of the National Bureau of Standards, Vol. 18, April 1937.

Heating, Ventilating and Air Conditioning Courses

LAST year a table of courses in heating, ventilating and air conditioning was published in the September *Heating, Piping and Air Conditioning* in response to numerous requests for information regarding instructional courses. Based on material furnished by the registrars of over 100 universities, colleges and technical schools, this table has been amplified to include additional institutions in the United States and Canada.

Supplementary tables will be published, giving detailed information regarding other schools which initiate courses in this field of engineering. Information is given for those individuals desiring evening instruction or correspondence courses, as well as a full undergraduate program in a regular engineering curriculum.

Universities, Colleges and Technical Schools Offering Courses in Heating, Ventilating and Air Conditioning, 1937-38

NAME	ADDRESS	INSTRUCTORS	Registration Date	SESSION	FEE	SUBJECTS	REMARKS
EAST							
Carnegie Institute of Technology	Pittsburgh, Pa.	C. M. Humphreys	Sept. 25	Day	$300 per year	Basic Thermodynamics, Plumbing, Heating, Ventilating	4-year Mech. Engr. Option in Plumbing, Heating, Ventilating, beginning Soph. yr.
			Oct. 5	Evening	$35-$40 per yr.	Basic Thermodynamics, Plumbing, Heating, Ventilating, Air Conditioning	Courses leading to Certificate and Degrees
Clemson Agricultural College	Clemson, S. C.	D. H. Shenk	Sept.9	Day	Regular Tuition	Basic Thermodynamics, Heating and Ventilating	Option in Mech. Engr. Courses
College City of New York	New York, N. Y.	J. Weiss	Sept. 21	Evening	$27.50	Heating and Ventilating	Presented in connection with Architecture and Building Construction Courses
Columbia Technical Institute	Washington, D. C.	Malcolm Hickox S. L. Richmond	Sept. 15	Evening and Correspondence	Tuition fee	Heating, Ventilating and Air Conditioning	Option in Mech. Engr. and one-year Certificate Course
Columbia University	New York, N. Y.	R. W. Waterfill C. A. Bulkeley	Sept. 21	Evening	$30 per course	Elementary and Advanced Courses in Air Conditioning	Presented in School of Architecture
Connecticut State College	Storrs, Conn.	W. L. Edel	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heat Engineering	Courses in Mech. Engr.
Cornell University	Ithaca, N. Y.	F. O. Ellenwood C. O. Mackey	Sept. 28	Day	Regular Tuition	Basic Thermodynamics, Air Conditioning, Refrigeration	Graduate Courses and Required or Optional in Mech. Engr.
Drexel Institute of Technology	Philadelphia, Pa.	E. J. Berllet J. H. Rushton	Sept. 8	Evening	Regular Tuition	Basic Thermodynamics, Air Conditioning	Diploma Course in Mech. Engr.
Georgia School of Technology	Atlanta, Ga.	R. S. King	Sept. 15	Day and Evening	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Refrigeration	Presented in Mech. Engr. Course
Harvard University	Cambridge, Mass.	C. H. Berry F. R. Ellis C. P. Yaglou	Sept. 28	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Graduate Courses and Required or Elective in Mech. Engr.
Herkimer Institute	New York, N. Y.	Harold L. Alt John W. Schulz		Day and Evening	Tuition fee	Air Conditioning and Refrigeration	
International Correspondence Schools	Scranton, Pa.	B. B. Mahon		Correspondence	Course fee	Air Conditioning	
Lehigh University	Bethlehem, Pa.	E. H. Jennings	Sept. 21	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required and Elective in Mech. Engr.
Massachusetts Institute of Technology	Cambridge, Mass.	James Holt	Sept. 21	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, and Air Conditioning	Graduate Courses and Required or Elective in Mech. Engr.
Massachusetts University Extension Division	Boston, Mass.	J. A. Moyer		Correspondence	Course fees	Air Conditioning	
Newark College of Engineering	Newark, N. J.	F. D. Carvin	Sept. 14	Day and Evening	$30	Heating and Ventilating	Senior Mech. Engr. Course
New York University	New York, N. Y.	M. C. Giannini A. A. Adler	Sept. 8	Day and Evening	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	2-year Certificate Program and Graduate Courses in Mech. Engr.
North Carolina	Raleigh, N. C.	F. B. Turner L. L. Vaughn		Short Course	$45	Heating and Air Conditioning	Supplemented with Elementary Electricity, Drawing and Mathematics
Pennsylvania State College	State College, Pa.	H. A. Everett	Sept. 10	Day	Regular Tuition	Basic Thermodynamics, Heating and Ventilating	Required Course in Mech. Engr.
Polytechnic Institute of Brooklyn	Brooklyn, N. Y.	John James	Sept. 18	Evening	$35 per semester	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Elective Course in Mech. Engr.
Pratt Institute	Brooklyn, N. Y.	J. W. Hunter	Sept. 15	Day and Evening	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required and Elective Mech. Engr. Course
Rensselaer Polytechnic Institute	Troy, N. Y.	E. A. Fessenden	Nov. 1	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Senior Course in Mech. Engr.
Rutgers University	New Brunswick, N. J.		Sept. 15	Correspondence	$25 per course	Heating, Ventilating, Air Conditioning	

NAME	ADDRESS	INSTRUCTORS	Registration Date	SESSION	FEE	SUBJECTS	REMARKS
Stevens Institute of Technology	Hoboken, N. J.	E. H. Fezandie J. I. Yellott	Sept. 22	Day	Regular Tuition	Basic Thermodynamics, Heating, Air Conditioning, Ventilating	Graduate Courses and Required or Elective in Mech. Engr.
Tufts College	Tufts College, Mass.	E. MacNaughton	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required in Mech. Engr. Course
University of Delaware	Newark, Del.	R. L. Spencer	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Presented in Mech. Engr. Courses
University of Florida	Gainesville, Fla.	N. C. Ebaugh	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required and Elective Mech. Engr. Course
University of Maryland	College Park, Md.	R. S. Dill	Sept. 17	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Refrigeration	Presented in Mech. Engr. Courses
University of New Hampshire	Durham, N. H.	E. H. Stolworthy	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating	Required Mech. Engr. Course
University of North Carolina	Raleigh, N. C.	L. L. Vaughan F. B. Turner	Sept. 15	Day Correspondence	Regular Tuition $7.50 Course	Basic Thermodynamics, Heating, Air Conditioning, Refrigeration Air Conditioning	Presented in Senior Mech. Engr. Course Extension Division
University of Pennsylvania	Philadelphia, Pa.	W. A. Sloan	Sept. 28	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating	Presented in Mech. Engr. Course
Villanova College	Villanova, Pa.	J. S. Morehouse	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required Senior Course in Mech. Engr.
Virginia Polytechnic Institute	Blacksburg, Va.	J. I. Clower	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Presented in Mech. Engr. Course
Wentworth Institute	Boston, Mass.	M. G. Noles	Sept. 21	Day and Evening	Regular Tuition	Air Conditioning	Certificate Course
West Virginia University	Morgantown, W. Va.	J. B. Grumbein	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating and Ventilating	Presented in Mech. Engr. Course
Worcester Polytechnic Institute	Worcester, Mass.	R. P. Kolb	Sept. 28	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating	Presented in Mech. Engr. Course
Yale University	New Haven, Conn.	L. E. Seeley	Sept. 21	Day	Regular Tuition	Basic Thermodynamics, Heating and Air Conditioning	Graduate Courses and Required or Elective Mech. Engr.
CENTRAL							
Arkansas State College	State College, Ark.	N. H. Brown	Sept. 7	Day	Regular Tuition	Refrigeration and Air Conditioning	Course in Engineering
Armour Institute of Technology	Chicago, Ill.	Le Roy Shields H. N. Nachman	Sept. 28	Day and Evening	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required in Mech. Engr. Course
Case School of Applied Science	Cleveland, Ohio	G. L. Tuve C. A. McKeeman	Sept. 21	Day and Evening	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required and Elective in Mech. Engr. Course
Chicago Technical College	Chicago, Ill.	W. T. Hooper Albert Pelletier	Sept. 8	Day, Evening, Correspondence	Course Fees	Air Conditioning	Short Course, four to nine months
David Ranken Jr.	St. Louis, Mo.		Sept. 8	Day and Evening	Course Fees	Air Conditioning	Course, one to three years
Fenn College	Cleveland, Ohio	Vincent Eaton	Sept. 23	Evening	$31 Elementary $18.50 Advanced	Elementary and Advanced Air Conditioning	
Kansas State College	Manhattan, Kan.	A. J. Mack B. B. Brainard	Sept. 14	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required and Elective in Mech. Engr. Course
Lewis Institute	Chicago, Ill.	V. L. Sherman Mr. Bodinus	Sept. 21	Day and Evening	$25 per term	Air Conditioning, Refrigeration	
McKim Technical Institute	Akron, Ohio			Day and Evening	$175.50	Refrigeration and Air Conditioning	Combined Course
Michigan College of Mining and Technology	Houghton, Mich.	A. P. Young	Sept. 24	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating	Elective in Mech. Engr. Course
Mississippi State College	State College, Miss.	R. C. Carpenter	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating	Required in Mech. Engr. Course
Ohio Mechanics Institute	Cincinnati, Ohio	J. T. Faig		Evening		Heating, Ventilating, Air Conditioning	
Ohio State College	Columbus, Ohio	A. I. Brown	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required and Elective in Mech. Engr. Course
Oklahoma Agricultural and Mechanical College	Stillwater, Okla.	V. W. Young		Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Offered in Architectural Dept. and Mech. Engr. Course
Purdue University	Lafayette, Ind.	W. T. Miller	Sept. 12	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Graduate Courses and Required or Elective in Mech. Engr.
Refrigeration & Air Conditioning Institute, Inc.	Chicago, Ill.	E. V. Hill		Correspondence and Shop	$147	Air Conditioning, Refrigeration, Heating, and Ventilation	Following completion of the home study work, the student is given two weeks of laboratory and shop training at Chicago
St. Louis Technical Institute	St. Louis, Mo.	O. W. Kothe		Correspondence	Course Fees	Heating, Ventilating, Air Conditioning	
University of Akron	Akron, Ohio	F. S. Griffin	Sept. 5	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating	Course in Mech. Engr.
University of Cincinnati	Cincinnati, Ohio	C. A. Joerger	Sept. 21	Evening	$20 per year	Heating and Ventilating	Alternate Course in Air Conditioning given 1938

NAME	ADDRESS	INSTRUCTORS	Registration Date	SESSION	FEE	SUBJECTS	REMARKS
University of Dayton	Dayton, Ohio	A. R. Weber	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Air Conditioning	Required courses in Mech. Engr.
University of Detroit	Detroit, Mich.	F. J. Linsenmeyer	Oct. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required in Mech. Engr. Course
University of Illinois	Urbana, Ill.	W. H. Severns	Sept. 21	Day Correspondence	Regular Tuition $20	Basic Thermodynamics, Heating, Ventilating, Air Conditioning Heating, Ventilating, Air Conditioninng	Graduate Courses and Required or Elective in Mech Engr.
University of Kentucky	Lexington, Ky.	L. S. O'Bannon	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required or Elective in Mech. Engr. Course
University of Louisville	Louisville, Ky.		Sept. 8	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Courses in Mech. Engr.
University of Minnesota	Minneapolis, Minn.	F. B. Rowley A. B. Algren	Sept. 21	Day and Correspondence	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Graduate Courses and Required or Elective in Mech. Engr.
University of Missouri	Columbia, Mo.	Mr. Gray	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Air Conditioning	Course in Mech. Engr.
University of Nebraska	Lincoln, Neb.	A. E. Luebs	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Refrigeration, Heating, Ventilation	Elective in Mech. Engr. Course
University of Oklahoma	Norman, Okla.	W. H. Carson E. F. Dawson	Sept. 9	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Graduate Courses and Required or Elective in Mech. Engr.
University of Tennessee	Knoxville, Tenn.	C. E. Ferris	Sept. 17	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required in Mech. Engr. Course
University of Wisconsin	Madison, Wis.	G. L. Larson	Sept. 21	Day and Correspondence	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Graduate Courses and Required or Elective in Mech. Engr.
Washington University	St. Louis, Mo.	E. L. Ohle	Sept. 21	Day	Regular Tuition	Basic Thermodynamics, Heating, Air Conditioning	Elective in Mech. Engr. Course
WEST Agricultural and Mechanical College of Texas	College Station, Texas	C. W. Crawford	Sept. 21	Day	$50 per year	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Elective in Mech. Engr. Course
California Polytechnic School	San Luis Obispo, Calif.	C. E. Knott		Day	$20 per year	Air Conditioning	Two-year Course, Training for Installation and Maintenance
International Engineering Institute	Seattle, Wash.	C. W. Parsons	Oct. 1	Day, Evening, Correspondence	$300 per year $160 (Corres.)	Air Conditioning	
Oregon State College	Corvallis, Oregon	M. C. Phillips W. H. Martin E. C. Willey	Sept. 21	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Graduate Courses and Required or Elective in Mech. Engr.
State College of Washington	Pullman, Wash.	Mr. Thornton	Sept. 21	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Elective in Mech. Engr. Course
University of Arizona	Tucson, Arizona	P. M. Thornburg	Sept. 14	Day	Regular Tuition	Basic Thermodynamics, Air Conditioning	Elective in Mech. Engr. Course
University of California	Berkeley, Calif.	B. M. Woods B. F. Raber L. M. K. Boelter	Sept. 18	Day Evening	Regular Tuition $9 per person ten meetings	Basic Thermodynamics, Heating, Ventilating, Air Conditioning Fundamentals of Air Conditioning	Graduate Courses and Required or Elective in Mech. Engr. Presented by University Extension in San Francisco
University of Colorado	Boulder, Col.	S. L. Simmering	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required in Mech. Engr. Course
University of New Mexico	Albuquerque, N. M.	M. E. Farris	Sept. 14	Day	Regular Tuition	Basic Thermodynamics, Air Conditioning	Optional in Mech. Engr. Course
University of Santa Clara	Santa Clara, Calif.	G. L. Sullivan	Aug. 28	Day	Regular Tuition	Basic Thermodynamics, Heating, Air Conditioning	Presented in Mech. Engr. Course
University of Southern California	Los Angeles, Calif.	T. T. Eyre	Sept. 16	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required in Mech. Engr. Course
University of Texas	Austin, Texas	H. E. Degler	Sept. 18	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Elective in Mech. Engr. Course
University of Utah	Salt Lake City, Utah	E. H. Beckstrand	Sept. 28	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required and Elective in Mech. Engr. Course
University of Washington	Seattle, Wash.	E. O. Eastwood	Sept. 15	Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Required and Elective in Mech. Engr. Course
CANADA Montreal Technical School	Montreal, Quebec		Sept. 8	Day	Regular Tuition	Heating, Ventilating, Air Conditioning	Regular Technical Course
Nova Scotia Technical College	Halifax, Nova Scotia			Day	Regular Tuition	Heating, Ventilating	
University of Manitoba	Winnipeg, Manitoba			Day	Regular Tuition	Heating, Ventilating, Air Conditioning	Course for Architectural Students
University of Toronto	Toronto, Ontario			Day	Regular Tuition	Basic Thermodynamics, Heating, Ventilating, Air Conditioning	Presented in Mech. Engr. Course

The Inspiration of Society Membership

A. C. Willard

The chairman of the Membership Committee, Mr. Bolsinger, has asked me to write rather intimately and from a purely personal angle about my connection with the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS: Why I Joined the Society and Am Still a Member. I am glad to comply with his request and I trust the reader will understand, therefore, why my statements are so highly personalized.

I joined the Society (A.S.H.V.E.) in order to get acquainted with the men who were the leaders in this field of engineering and to find out what they were thinking about. In other words, what were their personal opinions on the many problems always confronting the heating and ventilating engineer. It wasn't necessary to join the Society in order to get acquainted with what these men **had** done. The various technical magazines as well as the Society JOURNALS and TRANSACTIONS supply such information. But I wanted to know what was **going** to be done.

I hoped to meet these leaders and know them as individuals with ideas and convictions of their own, often quite at variance with the ideas and convictions of their colleagues. Well, it worked out far better than I had anticipated for I found these men were not only friendly but also anxious to be helpful, provided one showed an intelligent and sympathetic interest in the Society and its objectives as well as in one's own private problems.

Indeed, it was immediately apparent that the men whom I wished to meet and to know became interested in me because I was interested in the Society and what it was trying to do. They believed that men engaged in any professional field have an obligation to that profession and they were willing to devote time, energy and money in fulfilling this obligation. It was and is a great inspiration to meet and to know such men, and to work with them in advancing Society objectives.

Incidentally, it is my opinion that no professional society, worthy of the name, could exist long without such members. They have the vision to see that unless professional standards, as well as the technical knowledge required in the practice of the profession, are constantly scrutinized, improved, and augmented the value of the Society to its members and the public will diminish and eventually disappear. The men who founded the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS recognized these demands, and the men who are now active in the Society are even more determined to carry on such an important and constructive program for the good of the profession as a whole.

Not only did I gain inspiration and satisfaction by close association in a common enterprise with a group of fine gentlemen, but I also gained a great deal of valuable technical knowledge and a broad view of the whole field of heating and ventilating engineering. All this was very valuable to me even though I was engaged in teaching and research rather than in active private practice. I am sure my teaching was made more vital, and I know my research activities were greatly stimulated by these personal contacts with the members of the Society.

And now, as I look back upon those active days in Society affairs, I realize that I got out of it all far more than I put into it in energy, time and money. Of course, I attended the regular meetings; that was why I joined, and there were a good many committee meetings too, which also required time and some money, but it was more than worth what it cost in every way.

But best of all and beyond cost and price were the many personal friendships which I am sure I would never have made in any other way except as a member of the Society. These I would not exchange for all the purely professional contacts and the honors resulting from my Society activities and associations. It is for all these reasons that I value my membership so highly and shall continue it not only as a mark of appreciation of all that the A.S.H.V.E. has done for me during the past twenty-five years, but also in order to keep in touch with the leading men and the ever increasing progress in this great field of engineering.

NOMINATIONS FOR 1938

The Nominating Committee appointed to select candidates for Officers of the Society for the coming year, 1938, submits the following list of nominees:

For President:

E. H. GURNEY, Toronto, Ont., Can.

For First Vice-President:

J. F. MCINTIRE, Detroit, Mich.

For Second Vice-President:

F. E. GIESECKE, College Station, Tex.

For Treasurer:

A. J. OFFNER, New York, N. Y.

For Members of the Council:

Three-Year Term

N. D. ADAMS, Rochester, Minn.
A. P. KRATZ, Urbana, Ill.
J. H. WALKER, Detroit, Mich.
G. L. WIGGS, Montreal, Que., Can.

Respectfully submitted,

NOMINATING COMMITTEE,

N. D. ADAMS, *Chairman*
C. E. PRICE, *Secretary*

In accordance with the provisions of the Amended Constitution, as given, ballots containing the names of the above candidates will soon be sent to the membership for voting upon prior to the Annual Meeting in January.

Art. B-VIII—Section 10. The Nominating Committee shall consist of one (1) member eligible to vote designated by each Chapter, or his alternate also appointed by the Chapter. The Secretary of each Chapter shall certify to the Secretary of the Society on or before January first the names of the member and alternate selected.

The Committee shall meet at the Annual Meeting of the Society at the call of the Secretary of the Society and shall effect its own organization and elect its own Chairman. At the Semi-Annual Meeting of the Society, if possible, the Nominating Committee shall select the nominees for the ensuing year for the offices of President, First Vice-President, Second Vice-President, Treasurer, and four (4) members of the Council. In any event the names of the nominees shall be certified to the Secretary of the Society before September twentieth, with the written consent of each nominee to fill the office for which he has been selected and their names with the offices to which they have been nominated shall be published in the October issue of the JOURNAL.

Art. B-IX—Section 2. The Secretary shall prepare ballots with the names of all candidates and forward them to the members, eligible to vote, at least thirty (30) days before the date of the Annual Meeting.

Nominations for Members of Committee on Research

Although committees of the Society are usually appointed, in view of the great importance of the Committee on Research and the financial responsibility it would be called upon to assume, it has been made more representative of the entire membership of the Society by a process of *election*. The election is governed by the By-Laws for the election of officers, with the single exception that Members of the Committee on Research are nominated by the Council instead of by a Nominating Committee.

In accordance with the Regulations for the Government of the Research Laboratory, adopted at the January, 1919, Meeting, and amended January, 1933, the Council announces the nomination of the following members of the Committee for election to succeed those members whose present terms expire January, 1938:

Three-Year Term

M. K. FAHNESTOCK, Urbana, Ill.
W. L. FLEISHER, New York, N. Y.
R. J. TENKONOHY, St. Louis, Mo.
T. H. URDAHL, Washington, D. C.
B. M. WOODS, Berkeley, Calif.

The regulations governing the nomination and election of members of the Committee on Research are as follows:

ARTICLE II—ORGANIZATION

Section 1. *Committee on Research*—There shall be a standing committee known as the Committee on Research, consisting of fifteen (15) members each serving for three (3) years and five (5) retiring each year. The outgoing Chairman if serving in that capacity during the last year of his three (3) year term on the Committee shall without election become an additional member of the Committee on Research for one (1) year.

(*a*) The Council shall nominate previous to July first of each year five (5) members to fill the vacancies of those retiring at the next Annual Meeting.

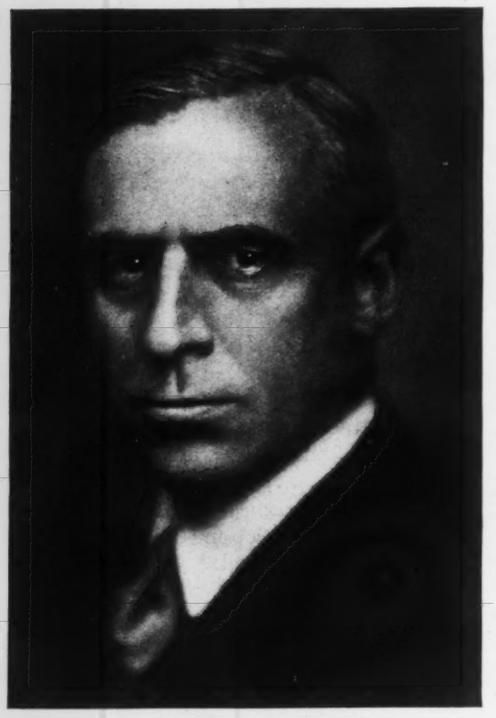
(*b*) The nominations made by the Council shall be published in the October issue of the Society's JOURNAL.

(*c*) Any ten (10) members of the Society eligible to vote may present to the Secretary over their signatures, the name of one (1) or more additional nominees for the Committee on Research, provided such name or names are presented at least sixty (60) days prior to the next Annual Meeting, and such additional nominations shall be placed on the ballot opposite the nominations made by the Council.

(*d*) The election shall otherwise conform to the regulations provided for the election of officers of the Society in the Constitution, By-laws and Rules.

(*e*) Vacancies may be filled by the Council, such persons chosen by the Council to serve until a successor is elected at the next Annual Meeting.

Nominees for A. S. H. V. E. Officers in 1938



E. H. GURNEY
Toronto, Can.
President

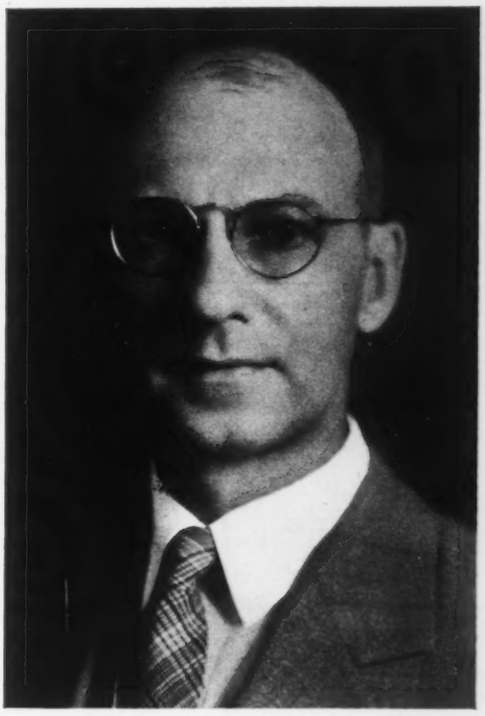
J. F. MCINTIRE
Detroit, Mich.
First Vice-President

F. E. GIESECKE
College Station, Tex.
Second Vice-President

ALFRED J. OFFNER
New York, N. Y.
Treasurer

Council Members Nominated for Three-Year Term

N. D. Adams
Rochester, Minn.



A. P. Kratz
Urbana, Ill.

J. H. Walker
Detroit, Mich.

G. L. Wiggs
Montreal, Can.

Pittsburgh Experiment Station of the U. S. Bureau of Mines where the Research Laboratory of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS *is located*

COMMITTEE ON RESEARCH

W. A. DANIELSON, *Chairman;* W. L. FLEISHER, *Vice-Chairman;* F. C. HOUGHTEN, *Director;* DR. A. C. WILLARD, *Technical Adviser;* A. C. FIELDNER, *Ex-Officio Member. One year:* C. A. DUNHAM, W. L. FLEISHER, ELLIOTT HARRINGTON, A. P. KRATZ, H. C. MURPHY. *Two Years:* W. A. DANIELSON, C. E. LEWIS, D. W. NELSON, C. TASKER, C.-E. A. WINSLOW, *Three Years:* H. E. ADAMS, A. E. STACEY, G. L. TUVE, J. H. VAN ALSBURG, J. H. WALKER.

Executive Committee: W. A. Danielson, *Chairman;* W. L. Fleisher, J. H. Walker.

Technical Advisory Committees

Committee on Air Cleaning—IP-4: H. C. Murphy,* *Chairman;* M. I. Dorfan, C. E. Lewis,* S. R. Lewis, G. W. Penney, A. L. Simison, W. O. Vedder.

Committee on Air Conditioning Requirements of Glass—IF-18: M. L. Carr, *Chairman;* F. L. Bishop, A. N. Finn, E. H. Hobbie, R. J. Lillibridge, R. A. Miller, F. W. Parkinson, W. C. Randall, L. T. Sherwood, J. T. Staples, C. Tasker,* G. B. Watkins, F. C. Weinert.

Committee on Air Distribution—IP-21: Ernest Szekely, *Chairman;* S. H. Downs, M. K. Fahnestock, F. J. Kurth, D. W. Nelson,* C. H. Randolph, J. E. Schoen, G. L. Tuve,* J. H. Van Alsburg.*

Committee on Air Friction—IP-6: J. H. Van Alsburg,* *Chairman;* C. A. Booth, S. H. Downs, C. M. Humphreys, R. D. Madison, L. B. Miller, L. G. Miller.

Committee on Atmospheric Impurities and Resulting Safety and Health Requirements—IP-26: Theodore Hatch, *Chairman;* J. J. Bloomfield, C. A. Booth, Philip Drinker, Dr. Leonard Greenburg, Elliott Harrington,* H. B. Meller.

Committee on Climate and Air Conditioning—C-24: Dr. C. A. Mills, *Chairman;* Major G. C. Dunham, James Govan, Dr. W. J. McConnell, C. F. Neergaard, Dr. F. M. Pottenger, Jr., E. L. Weber, Prof. C.-E. A. Winslow.*

Committee on Comfort Air Conditioning—OH-22: C. Tasker,* *Chairman;* A. E. Beals, F. R. Bichowsky, Thomas Chester, F. E. Giesecke, Elliott Harrington,* R. E. Keyes, A. B. Newton, C. P. Yaglou.

Committee on Corrosion in Air Conditioning Equipment—IF-14: A. E. Stacey, Jr.,* *Chairman;* A. F. L. Anderson, M. L. Diver, F. L. LaQue, C. E. Lewis,* R. M. Palmer, F. N. Speller, C. M. Sterne, R. T. Thornton, J. H. Young.

Committee on Corrosion in Steam Systems—IF-2: J. H. Walker,* *Chairman;* W. H. Driscoll, C. A. Dunham,* L. B. Miller, R. R. Seeber, F. N. Speller, C. M. Sterne.

Committee on Effect of Water on Roofs—IF-29: A. B. Snavely, *Chairman;* M. R. Beasley, J. B. Griffiths, Elliott Harrington,* E. H. Hyde, W. L. Murray, E. R. Queer, C. S. Reeve, E. T. Selig, Jr.

Committee on General Air Conditioning Comfort Requirements—OH-5: C. P. Yaglou, *Chairman;* J. J. Aeberly, R. R. Sayers, C.-E. A. Winslow.*

Committee on Heat Requirements of Buildings—IF-8: O. W Armspach, *Chairman:* P. D. Close, W. H. Driscoll, H. M. Hart, V. W. Hunter, H. H. Mather, E. C. Rack, F. B. Rowley, R. J. J. Tennant, J. H. Walker.*

Committee on Heat Transfer of Finned Tubes with Forced Air Circulation—IP-10: F. B. Rowley, *Chairman;* H. F. Hutzel, R. H. Norris, C. H. Randolph, W. E. Stark, G. L. Tuve,* C. F. Wood.

Committee on Insulation—IF-23: L. A. Harding, *Chairman;* E. A. Allcut, H. C. Bates, H. C. Dickinson, J. D. Edwards, E. C. Lloyd, W. E. McMullen, R. T. Miller, E. R. Queer, T. S. Rogers, F. B. Rowley, W. S. Steele, C. Tasker,* B. Townshend, G. B. Wilkes.

Committee on Intermittent Heating—IP-20: E. K. Campbell, *Chairman;* W. L. Cassell, Prof. E. F. Dawson, N. W. Downes, F. E. Giesecke, J. M. Robertson, J. H. Kitchen, Prof. A. H. Sluss, G. L. Tuve.*

Committee on Psychrometry—C-11: F. R. Bichowsky, *Chairman;* C. A. Bulkeley, J. A. Goff, Dr. E. V. Hill, F. G. Keyes, A. P. Kratz,* W. M. Sawdon.

Committee on Radiation with Gravity Air Circulation—IP-9: M. K. Fahnestock, *Chairman;* B. C. Benson, H. F. Hutzel, J. P. Magos, J. W. McElgin, J. F. McIntire, D. W. Nelson,* R. N. Trane, T. A. Novotney.

Committee on Relation of Body Changes to Air Changes—OH-3: Dr. E. V. Hill, *Chairman;* N. D. Adams, J. J. Aeberly, John Howatt, A. P. Kratz,* P. J. Marschall, V. L. Sherman.

Committee on Sound Control—IF-1: J. S. Parkinson, *Chairman:* C. M. Ashley, G. F. Drake, V. O. Knudsen, R. F. Norris, C. H. Randolph, J. P. Reis, A. E. Stacey,* G. T. Stanton, F. R. Watson.

Committee on Summer Air Conditioning for Residences—IP-7: M. K. Fahnestock, *Chairman;* E. A. Brandt, John Everetts, Jr., Elliott Harrington,* H. F. Hutzel, E. D. Milener, K. W. Miller, E. B. Newill, F. G. Sedgwick, J. H. Walker.*

Committee on Transportation Air Conditioning—C-12: L. E. Miller, *Chairman;* T. R. Crowder, F. B. Rowley, A. E. Stacey, Jr.,* L. W. Wallace.

Committee on Treatment of Air with Electricity—C-17: Prof. C.-E. A. Winslow,* *Chairman;* R. D. Bennett, W. H. Carrier, L. W. Chubb, Major W. D. Fleming, R. F. James, L. R. Koller, Dr. C. A. Mills, Prof. E. B. Phelps, Prof. G. R. Wait, Prof. W. T. Wells.

Committee on Weather Design Conditions—IF-31: W. E. Stark, *Chairman;* E. W. Goodwin, A. C. Grant, J. H. Kincer, A. P. Kratz,* L. S. Ourusoff.

*Member of Committee on Research.

A. S. H. V. E. RESEARCH

A Page of News Notes and Comment

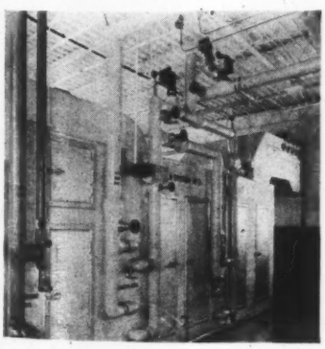
By **Brewster S. Beach***

FIELD TESTS CLIMAX NEW COMFORT RESEARCH

View in engineering department where A. S. H. V. E. cooperative comfort tests are taking place

Continuing its research into the physiological reactions of people to conditioned air as part of the broad program to improve the comfort chart data, the Committee on Research is sponsoring tests among office workers at the plant of the Minneapolis-Honeywell Regulator Co. at Minneapolis.

This investigation is now in its final stages and the data collected will be the basis of a technical paper designed to add to the present knowledge concerning summer comfort cooling requirements, which has been developed by investigations carried on at the Ontario Research Foundation, under C. Tasker, chairman of the Committee on Comfort Air Conditioning, at the Texas College of Agriculture and Mechanical Engineering under Prof. F. E. Giesecke and at the Research Laboratory of the Society in Pittsburgh.



One of the dehumidifier systems serving offices

In the latest tests at Minneapolis, 250 subjects of different ages and both sexes were chosen. They are engaged in engineering work making calculations, designing controls and using the drafting boards. Another group is in the stenographic department while others are engaged in various clerical labors. Four engineers of the company are supervising the study, which is significant in the fact that this is the first time that other than a laboratory investigation has been carried out.

Three systems of air conditioning have been in use to provide 70 to 71 deg effective temperature; 73 deg effective temperature and 75 to 76 deg effective temperature. Although the analysis of the data collected has not been completed, the investigators feel that progress has been made in more closely defining the variations of effective temperatures under which office workers are most comfortable.

*Director, Information Service, Committee on Research.

GLASS INSULATION SUBJECT OF CONCERTED RESEARCH

R. A. Miller

A concerted attack on insulation problems offered by the new uses of glass building materials has been organized through the Technical Advisory Committee on the Air Conditioning Requirements of Glass, of which M. L. Carr is chairman. Following a recent meeting in Pittsburgh, it was announced that special funds have been raised from various interested manufacturers and from some of the window and weatherstrip manufacturers. R. A. Miller, technical sales engineer of the Pittsburgh Plate Glass Co., was particularly active and primarily responsible for contributions from his industry, while W. C. Randall succeeded in raising funds from the metal window manufacturers.

A four point program was adopted: (1) To distribute available current data; (2) To prepare a comprehensive bibliography of current literature on the subject; (3) To cooperate with manufacturers and others carrying on research in which the committee may be interested and to offer the services of the committee in supervising such work; (4) To employ the services of a special man to undertake a detailed study of all existing data as the basis for further research leading to tests of materials under laboratory and operating conditions.

General supervision of the program will be in the hands of F. C. Houghten, director of the Society's Research Laboratory. As the work is broadened in scope and additional funds are collected, it is the hope of the Committee to cover the interests of the wood window, weatherstrip and various sun arresting appurtenance manufacturers. This investigation has been initiated out of the need for more comprehensive and unbiased research data relating to the insulating characteristics of the materials in question, both for summer and winter air conditioning requirements. The following are among the glass manufacturers contributing funds for this special research work: Owens-Illinois Glass Co., Toledo; American Window Glass Co., Pittsburgh; Mississippi Glass Co., New York, N. Y.; Pennsylvania Wire Glass Co., Philadelphia; Franklin Glass Corp., Butler; Pittsburgh Plate Glass Co., Pittsburgh; Libbey-Owens-Ford Glass Co., Toledo; Blue Ridge Glass Corp., Kingsport, Tenn., and N. S. W. Co., Detroit.

NEW RESEARCH REPRESENTATIVE

S. L. Rolland, design engineer of the Oklahoma Gas and Electric Co., Oklahoma City, and a member of the Oklahoma Chapter, A.S.H.V.E., has been appointed Research Representative by E. F. Dawson, chapter president.

Correlating Thermal Research

As a part of the efforts of the A. S. H. V. E. Research Laboratory to correlate research in thermal engineering carried on by the many institutions engaged in such work, and to disseminate the published results of such studies together with other reports of progress in the field, and in order to make this information available to the membership of the Society, there will be published monthly on this page a limited number of brief abstracts of articles which it is believed will be of interest to all concerned. For more complete lists address the Librarian, A. S. H. V. E. Research Laboratory, U. S. Bureau of Mines Experiment Station, Pittsburgh, Pa.

F. C. Houghten, *Director.*

W. A. Danielson, *Chairman.*
COMMITTEE ON RESEARCH

• Thermal Conductivity of Artificial Materials, by S. Erk, A. Keller and H. Poltz. *Phys. Zeits.* vol. 38, pp. 394-402, June 1937. Description of apparatus for the determination of the thermal conductivity of thin plates of artificial materials by comparison with that of a boron crown glass plate. Results of densities and thermal conductivities of 46 materials, including compressed paper, compressed micanite and various synthetic resins at mean temperatures of about 40 degrees C are tabulated. The thermal conductivity of compressed materials increases with increase of density. Phenolic and urea resins, whether containing filling material or not, have all about the same thermal conductivity vis. 0.27± 0.06 K. cal/m. hr. degree C.

• Heat Transfer Equation for Fluid-flow in Tubes, by E. Hofmann. *Zeits. f. ges. Kalte-Ind.* vol. 44, pp. 99-107, June 1937. An equation is given which represents the heat interchange between a fluid and the walls of the tube through which it is flowing, more adequately than does the original Prandtl-ten Bosch equation. An analysis of all existing data indicates the constant *B* should have the value of 1.5.

• Use of Insulation Under High Humidity Conditions, by A. D. Edgar. *Refrigerating Engineering,* vol. 34, no. 3, Sept. 1937. Report of tests on storage of white potatoes in northern Maine by Bureau of Agricultural Engineering.

• Test Code for Mechanically Operated Household Refrigerators. *Refrigerating Engineering,* vol. 34, no. 3, Sept. 1937, pp. 157-159. New code published by Technical Committee of *N. E. M. A.* covers performance of domestic units.

• Briquetting Coal with Sodium Silicate, by Foster Dee Snell and Cyril S. Kimball. *Industrial Engineering Chemistry,* vol. 29, no. 6, pp. 724-726, 1937. Solution of silicic acid gel in sodium silicate used as a smokeless binder for briquets. When used with anthracite culm, the briquets burn completely, leaving an ash skeleton of the same shape as the briquet. Combustion characteristics of briquets are given, also method of making them more water resistant.

• Practical Duct Design and Fan Selection for Air Conditioning, by H. M. Hendrickson. *Refrigerating Engineering,* vol. 34, no. 3, Sept. 1937, pp. 163-166. Data on duct requirements in relation to capacity and friction. Data and discussion of fan selection.

• Analyses of Flue Gas from Natural Gas Fuels, by Henry Cooney. *Power Plant Engineering,* vol. XLI, no. 9, Sept. 1937, pp. 555-8. Discussion involving determination of proper CO_2 value and reliability of instruments used in study of combustion.

• Internally Fired Boilers, by A. F. Webber. *Journal of the Institute of Fuel,* vol. X, no. 53, June 1937, pp. 302-323. Potentialities of the application of modern combustion and heat transmission technique to the internally fired boiler. Discussion of the present internally fired boiler, the furnace, convective heat transfer. Locomotive boiler performance. Advantages and possibilities of internally fired boilers. Description and illustration of the early Roman internally heated water supply tank.

• The Coal Research Laboratory of the Carnegie Institute of Technology, by H. H. Lowry. *Journal of the Institute of Fuel,* vol. X, no. 53, June 1937, pp. 291-301. Report, with charts and tables, of tests made at C. I. T. on the understanding of the mechanism of thermal decomposition of coal. Four coal seams tested so far, Pittsburgh, Pocahontas, Illinois and High Splint.

• Reliability of Thermocouples, by D. Quiggle, C. O. Tongberg and M. R. Fenske. *Industrial and Engineering Chemistry,* vol. 29, pp. 827-830. Copper-copel and copper constantine thermocouples used in this test possess a rather high degree of reliability if used in the temperature range of 0 to 200 degrees C. Above that temperature they read high.

• The Measurement of Environmental Warmth, by T. Bedford. *The Colliery Guardian, London,* vol. CLV, no. 3996, July 30, 1937, pp. 191-195. Description of methods of determining atmospheric conditions including air temperature, humidity, air velocity, mean temperature of surroundings. Discussion of calibration and use of Kata thermometer and Globe Thermometer. Author favors effective temperature scale, of A. S. H. V. E., of warmth which allows for humidity, over the other three such scales which he describes, namely Wet Kata thermometer cooling power, Resultant Temperature and Equivalent Warmth.

• Natural Ventilation as Affecting Mechanical Ventilation, by R. A. H. Flugge-de-Smidt and E. C. Polkinghorne. *The Colliery Guardian, London,* vol. CLIV, no. 3991, June 25, 1937, pp. 1189-1193. Report of data taken in a deep coal mine of natural ventilation factors and their effect on mechanical ventilation of the mine.

• Flames and Combustion. Clarity of Flame Is a Practical Guide to Efficiency of Combustion, by A. Bement. *Power Plant Engineering,* vol. XLI, no. 9, Sept. 1937, p. 529. Discussion of flame formation and gases produced in burning coal in various types of forced draft furnaces.

• Sampling of Industrial Dusts by Means of the *Labyrinth,* by H. V. A. Briscol and others. *The Colliery Guardian, London,* vol. CLV, no. 3998, Aug. 13, 1937, pp. 283-288. Description and diagram of salicylic acid filter used to collect dust on wet surface. The *Labyrinth* was developed to collect dry samples of dust. It consists of an assembly of identical copper baffle plates across which air is drawn by a fan. Baffles may be removed at end of test and dust collected on each, weighed and observed.

• Pipe Corrosion and Coatings. Corrosion Survey. Part 13, by Erick Larson. *American Gas Journal,* vol. 147, no. 1, July 1937, pp. 31-3. Description of the following types of corrosion. Scale formation, pitting, graphitization, dezincification, erosion, cracking or fatigue form.

• Dry Ice from Flue Gas, by D. H. Killefer and J. Wellford Martin. *Power,* vol. 81, Aug. 1937, pp. 442-443. Details of new process for obtaining dry ice from flue gas.

• Eye Protection for Firemen, by T. A. Walsh. *Power Plant Engineering,* vol. XLI, no. 9, Sept. 1937, p. 529. Filter glass that will absorb injurious invisible light rays and reduce glare are recommended for firemen for use in checking firebox conditions. Good welding glass of various shades is found best for stoker-fired boiler flame observation.

• Methods of Testing Insulating Refractories, by W. C. Rueckel. *The Bulletin of the American Ceramic Society,* vol. 16, no. 8, Aug. 1937, pp. 319-321. Methods used for determining the physical properties of insulating refractories are given and the utility rating of the various test methods and refinements in test procedure is discussed. Tests usual for insulating refractories are, reheat shrinkage, spalling, cold-crushing and transverse strength, hot load strength, porosity, permeability, and thermal conductivity.

• Transmission of Heat Through Metal Walls, by R. E. Light. *Power and Works Engineer,* vol. 32, pp. 108-112, 1937. Paper gives a comprehensive review, with tables and charts for establishing correct heat transfer values.

New York Will Entertain A. S. H.V. E. at 44th Annual Meeting

PROGRESS is being made in arranging a program for the Society's 44th Annual Meeting to be held at the Hotel Biltmore, January 24-28, 1938.

Announcements by the Committee on Arrangements and the Program Committee indicate that a joint session will be held with each of the following organizations: *American Society of Refrigerating Engineers* and the *National Warm Air Heating and Air Conditioning Association.* It is expected that twelve technical papers will be presented and among the subjects to be discussed are the following: Impurities in air, water cooling and water conservation, modern lighting and air conditioning design, performance of fan furnace systems, office building air conditioning, etc.

Arrangements are being made for an inspection of the new Midtown Tunnel connecting New Jersey and New York, as many of the members will be interested in the methods of heating and ventilating.

Entertainment will be provided by the New York Chapter of the Society and the work of the Committee on Arrangements is being directed by A. C. Buensod, chairman, and Alfred Engle, vice-chairman. Everyone engaged in the heating, ventilating and air conditioning industry will find it worthwhile to come to New York, January 24-28.

The Exposition

At Grand Central Palace during the week of January 24 there will be an extensive display of heating, ventilating and air conditioning equipment produced by leading manufacturers and this Fifth International Heating and Ventilating Exposition will bring a worldwide attendance. The engineering problems involved in heating, ventilating and air conditioning all commercial, factory and public buildings, as well as residences will be brought out in dramatic form at the Exposition. The keynote of the displays will be comfort and efficiency in every phase of living and working. The important functions that heating, ventilating and air conditioning play in modern life will be completely covered in the displays of equipment which will be found on three floors of Grand Central Palace.

The Fifth International Heating and Ventilating Exposition is under the personal direction of Charles F. Roth, president of the International Exposition Co.

Iowa-Nebraska Chapter Organized

On September 22 a group of members and others interested in the Society's work held a meeting at the Fontenelle Hotel, Omaha, and as a result a petition for a charter to organize the Iowa-Nebraska Chapter of the A.S.H.V.E. has been submitted to the Council.

A dinner meeting was held at 6:30 p. m. with members present from Omaha, Des Moines, Lincoln, Sioux City, and Scotts Bluff, and guests from various cities in Iowa and Nebraska. The meeting was called to order by M. J. Stevenson, Lincoln, who introduced A. V. Hutchinson, secretary of the A.S.H.V.E. He gave an outline of the Society's activities and then explained the procedure for organizing a local chapter.

A. L. Walters, Des Moines, was introduced and explained the value of chapter membership and told of some of his experiences as a member and officer of St. Louis Chapter.

Prof. R. A. Norman, Iowa State College, Ames, told of his interest in the organization of a chapter of Iowa-Nebraska members, and after a general discussion it was voted by those present to file a petition for a charter to organize the Iowa-Nebraska Chapter. The following temporary officers were elected:

M. J. Stevenson, Lincoln—*President.*
A. L. Walters, Des Moines—*Vice-President.*
F. L. Banner, Omaha—*Treasurer.*
W. R. White, Omaha—*Secretary.*

With President Stevenson in the chair a By-Laws Committee and a Membership Committee were appointed.

It was voted to hold the next meeting at Des Moines after the Council of the A.S.H.V.E. had voted on the petition for a charter.

NEWS OF LOCAL CHAPTERS

OFFICERS OF LOCAL CHAPTERS—1937

ATLANTA: *Organized,* 1937. *Headquarters,* Atlanta, Ga. *Meets,* First Tuesday. *President,* E. W. KLEIN, 152 Nassau St., N. W. *Secretary,* C. T. BAKER, 713 Glenn St., S. W.

CINCINNATI: *Organized,* 1932. *Headquarters,* Cincinnati, O. *Meets,* Second Tuesday in Month. *President,* I. B. HELBURN, 610 Chamber of Commerce Bldg. *Secretary,* H. E. SPROULL, 1005 American Bldg.

GOLDEN GATE: *Organized,* 1937. *Headquarters,* San Francisco, Calif. *Meets,* First Tuesday. *President,* B. M. WOODS, Univ. of Calif., Berkeley, Calif. *Secretary,* G. J. CUMMINGS, 113 Tenth St., Oakland, Calif.

ILLINOIS: *Organized* 1906. *Headquarters,* Chicago, Ill. *Meets,* Second Monday. *President,* L. S. RIES, Oberlin College, Oberlin, Ohio. *Secretary,* C. E. PRICE, 6 N. Michigan Ave.

KANSAS CITY: *Organized,* 1917. *Headquarters,* Kansas City, Mo. *Meets,* Second Monday in Month. *President,* A. H. SLUSS, 827 Mississippi Ave., Lawrence, Kan. *Secretary,* GUSTAV NOTTBERG, 914 Campbell St.

MANITOBA: *Organized,* 1935. *Headquarters,* Winnipeg, Man. *Meets,* Fourth Thursday. *President,* D. F. MICHIE, 492 Wardlaw Ave.

MASSACHUSETTS: *Organized,* 1912. *Headquarters,* Boston, Mass. *Meets,* Second Tuesday in Month. *President,* JAMES HOLT, Massachusetts Institute of Technology, Cambridge, Mass. *Secretary,* JOHN TURNER, 285 Columbus Ave.

MICHIGAN: *Organized,* 1916. *Headquarters,* Detroit, Mich. *Meets,* First Monday after the 10th of the Month. *President,* F. J. FEELY, 950 Trombley Rd., Grosse Pointe Pk. *Secretary,* G. H. TUTTLE, 2000 Second Ave.

WESTERN MICHIGAN: *Organized,* 1931. *Headquarters,* Grand Rapids, Mich. *Meets,* Second Monday in Month. *President,* W. W. BRADFIELD, 901 Michigan Trust Bldg. *Secretary,* S. W. TODD, JR., 309 Paris, S. E.

MINNESOTA: *Organized,* 1918. *Headquarters,* Minneapolis, Minn. *Meets,* Second Monday in Month. *President,* R. E. BACKSTROM, Room 1981, First Natl. Bank Bldg., St. Paul, Minn. *Secretary,* F. C. WINTERER, 836 Juno St., St. Paul, Minn.

MONTREAL. *Organized,* 1936. *Headquarters,* Montreal, Que. *Meets,* Third Monday. *President,* G. L. WIGGS, University Tower. *Secretary,* C. W. JOHNSON, 630 Dorchester St., W.

NEW YORK: *Organized,* 1911. *Headquarters,* New York, N. Y. *Meets,* Third Monday in Month. *President,* W. E. HEIBEL, 11 West 42nd St. *Secretary,* T. W. REYNOLDS, 100 Pinecrest Dr., Hastings-on-Hudson, N. Y.

WESTERN NEW YORK: *Organized,* 1919. *Headquarters,* Buffalo, N. Y. *Meets,* Second Monday in Month. *President,* B. C. CANDEE, 19 Tremont Ave., Kenmore, N. Y. *Secretary,* W. R. HEATH, 119 Wingate Ave.

NORTHERN OHIO: *Organized,* 1916. *Headquarters,* Cleveland, O. *Meets,* Second Thursday in Month. *President,* PHILIP COHEN, 401 East Ohio Gas Bldg. *Secretary,* C. A. MCKEEMAN, Case School of Applied Science.

OKLAHOMA: *Organized,* 1935. *Headquarters,* Oklahoma City, Okla. *Meets,* Second Monday. *President,* E. F. DAWSON, University of Oklahoma, Norman, Okla. *Secretary,* E. W. GRAY, Box 1498, Oklahoma City, Okla.

ONTARIO: *Organized,* 1922. *Headquarters,* Toronto, Ont. *Meets,* First Monday in Month. *President,* G. A. PLAYFAIR, 97 Jarvis St. *Secretary,* H. R. ROTH, 57 Bloor St. W.

PACIFIC NORTHWEST: *Organized,* 1928. *Headquarters,* Seattle, Wash. *Meets,* Second Tuesday in Month. *President,* W. W. Cox, 326 Columbia St. *Secretary,* M. N. MUSGRAVE, 314-9th Ave., N.

PHILADELPHIA: *Organized,* 1916. *Headquarters,* Philadelphia, Pa. *Meets,* Second Thursday in Month. *President,* L. P. HYNES, 240 Cherry St. *Secretary,* C. B. EASTMAN, 530 Brookview Lane, Brookline, Upper Darby, Pa.

PITTSBURGH: *Organized,* 1919. *Headquarters,* Pittsburgh, Pa. *Meets,* Second Monday in Month. *President,* M. L. CARR, P. O. Box 1646. *Secretary,* T. F. ROCKWELL, Carnegie Inst. Tech.

ST. LOUIS: *Organized,* 1918. *Headquarters,* St. Louis, Mo. *Meets,* First Tuesday in Month. *President,* G. W. F. MYERS, 3947 W. Pine Blvd. *Secretary,* D. J. FAGIN, 1344 Woodruff Ave.

SOUTHERN CALIFORNIA: *Organized,* 1930. *Headquarters,* Los Angeles, Calif. *Meets,* Second Tuesday in Month. *President,* E. H. KENDALL, 1978 S. Los Angeles St. *Secretary,* J. F. PARK, 1234 South Grand.

TEXAS: *Organized,* 1936. *Headquarters,* College Station, Texas. *President,* R. F. TAYLOR, 909 Banker's Mortgage Bldg., Houston, Tex. *Secretary,* W. H. BADGETT, Texas Engrg. Experiment Station, College Station, Tex.

WASHINGTON, D. C.: *Organized,* 1935. *Headquarters,* Washington, D. C. *Meets,* Second Wednesday in Month. *President,* L. OURUSOFF, 411 Tenth St., N. W. *Secretary,* L. F. NORDINE, Room 203, 734 Jackson Pl., N. W.

WISCONSIN: *Organized,* 1922. *Headquarters,* Milwaukee, Wis. *Meets,* Third Monday in Month. *President,* J. H. VOLK, 1906 W. St. Paul Ave. *Secretary,* H. C. FRENTZEL, 3000 W. Montana St.

B. M. Woods

G. J. Cummings

Golden Gate Chapter Meets

August 31, 1937. The first regular meeting of the new Golden Gate Chapter of the A.S.H.V.E. was held in San Francisco and action was taken to appoint committees and specify the rate of local dues.

The Chapter decided upon the first Tuesday of each month at noon as a regular meeting date, and Secy. G. J. Cummings was instructed to investigate the possibilities of meeting at the Engineers Club.

The ballots for officers as recommended by the Nominating Committee were counted and approved the slate of the Nominating Committee by a unanimous vote.

President—B. M. Woods
Vice-President—L. H. Cochran
Secretary—G. J. Cummings
Treasurer—C. E. Bentley
Board of Governors—A. J. Bouey, H. S. Haley, G. M. Simons.

Pittsburgh Chapter Holds First Fall Meeting

September 13, 1937. Forty-seven members and guests were present at the first fall meeting of Pittsburgh Chapter which was called to order at 7:40 p.m. in the downtown Y. M. C. A. by Vice-Pres. J. F. Collins, Jr., who presided.

Minutes of the last meeting held in April were read and approved, and a report of the Program Committee mentioned the advantages of the Speakers Bureau conducted by the Society.

The chairman then introduced A. V. Hutchinson, secretary of the A.S.H.V.E., who was present and described the operation of the Speakers Bureau and the new form of membership application now in use by the Society.

R. E. Moore, vice-president, Bell and Gossett Co., Chicago, was introduced by Mr. Collins and spoke on the subject of Forced Circulation Hot Water Heating Systems. Mr. Moore reviewed the history of hot water heating giving particular emphasis to pipe sizes. He discussed the present tendency toward closed systems with circulating pumps which permit small pipe sizes and the selection of radiators and convectors on the basis of higher heat emission values. Mr. Moore concluded his talk by explaining the method of using recently developed tables for sizing hot water piping.

According to the report of Secy. T. F. Rockwell, the meeting adjourned at 9:30 p.m.

I. B. Helburn

H. E. Sproull

Cincinnati Chapter

The activities of the Cincinnati Chapter which numbers 46 members on its roll will be conducted under the leadership of the following officers for the 1937-38 season:

President—I. B. Helburn
Vice President—O. W. Motz
Secretary-Treasurer—H. E. Sproull
Board of Governors—I. B. Helburn, E. B. Royer, O. W. Motz, H. E. Sproull and C. E. Hust.

A summary of the 1936-37 season is given in the annual report prepared by Secretary Sproull.

October 16, 1936. The first meeting of the season was held at the Engineers Club in Dayton, Ohio, attended by 47 members and guests. The speakers were T. L. Mart, president of the Marley Co., Kansas City, Mo., who spoke on the subject of Cooling Towers—Their Selection and Application, and, Anker Winther, a Cincinnati member, who gave a paper supplemented by slides on Evaporative Condensers.

November 10, 1936. G. L. Larson, Madison, Wis., president of the A.S.H.V.E., was guest of honor at the regular November meeting held at the Engineers Club. A resolution was passed expressing the deep regret of Cincinnati Chapter for the death of Mrs. H. N. Kitchell, wife of one of the oldest and most esteemed members. President Larson gave a brief resumé of THE 1937 GUIDE and then presented a paper entitled, The Economics of Good Construction as Related to Residence Heating. This meeting which was attended by 24 members and guests was preceded by a dinner at the Gibson Hotel and was enjoyed by all.

December 8, 1936. A meeting was held in the English Room of the Gibson Hotel with 11 members present. O. W. Motz was elected secretary-treasurer to fulfill the office held by K. W. Schick who had been transferred to Kansas City. The A.S.H.V.E. Research Laboratory paper, Cooling Requirements for Summer Comfort Air Conditioning, was then presented by Mr. Motz.

January 12, 1937. This evening was devoted to the annual party for members and their wives and was held at the Gibson Hotel.

February 19, 1937. A joint meeting of the *Cincinnati Technical and Scientific Societies*, was held at the Taft Auditorium. Many members from the various national technical societies were present and an address was given entitled, Waves, Words and Wires, by Frank A. Cowan of the Bell Telephone Co.

March 9, 1937. M. E. Newton, Minneapolis-Honeywell Regulator Co., addressed 28 members on the subject, Automatic Control as Applied to Air Conditioning. The meeting was held at the Gibson Hotel and was interesting and instructive.

April 28, 1937. E. H. Gurney, Toronto, Ont., Can., first vice-president of the A.S.H.V.E., was guest of honor at a dinner meeting held in the Rathskeller of the Hotel Gibson. Mr. Gurney's talk, When An Engineer Goes Sight Seeing, was exceedingly interesting and enjoyed by all. A report for new officers for the next year was submitted by the Nominating Committee.

May 11, 1937. The annual meeting of the Chapter was held at the Hartwell Country Club where 8 members played golf in the afternoon. A dinner meeting followed and was attended by 25 members. Officers for the coming year were elected.

G. H. Tuttle

Michigan Chapter

Secy. G. H. Tuttle of Michigan Chapter has prepared the annual report which gives the following officers and committees:

President—F. J. Feely.
Vice-President—F. J. Linsenmeyer
Secretary—G. H. Tuttle
Treasurer—J. S. Kilner
Board of Governors—R. K. Milward, F. R. Bishop, W. H. Old, S. S. Sanford
Membership Committee—W. G. Boales, *chairman.*
Program Committee—E. E. Dubry, *chairman*
Reception Committee—W. C. Randall, *chairman*
Publicity Committee—H. F. Hutzel, *chairman*
Affiliate Council of the Engineering Society of Detroit—R. K. Milward, G. D. Winans

The Chapter has a membership of 127 and held the following meetings during the season of 1936-37:

October 15, 1936. The opening meeting was held at the Wardell Hotel with approximately 65 members and guests present. Prof. G. L. Larson, Madison, Wis., president of the A.S.H.V.E. was the guest speaker and discussed Society activities and spoke on The Economics of Good Construction as Related to Residence Heating.

November 9, 1936. The November meeting was Chapter Night to honor J. F. McIntire, who had been nominated for second vice-president of the A.S.H.V.E. A guest speaker, J. D. Cun-

ningham, Federal Bureau of Investigation, discussed the Work and Functions of the Federal Bureau of Investigation. Approximately 100 members and guests attended.

December 14, 1936. The regular meeting was given over to a discussion of the research paper, Cooling Requirements for Summer Air Conditioning, and S. S. Sanford made the presentation. Approximately 85 members and guests attended.

January 18, 1937. The January meeting was attended by 130 members and guests. J. H. Walker, Detroit Edison Co., presented a Discussion of Some of the Engineering Problems in the Construction of a Windowless Building.

February 8, 1937. The Michigan Chapter's annual Valentine dinner dance was held at the Dearborn Inn with 102 present.

March 15, 1937. This meeting was the annual University Night and was held in the Physics Building of the University of Detroit. Prof. F. J. Linsenmeyer presented actual demonstrations of some of the Physical Phenomena of Air Conditioning. The meeting was attended by approximately 110.

April 22, 1937. E. H. Gurney, Toronto, Ont., first vice-president of the A.S.H.V.E., was guest of the Chapter and spoke on When An Engineer Goes Sightseeing. The new Technical Code for Mechanical Warm Air Heating was discussed by F. R. Bishop. The meeting was held at the Belcrest Hotel and 75 were present.

May 21, 1937. This was the annual golf meeting and election of officers. The meeting was held at the Meadowbrook Country Club and 65 members and guests were in attendance.

John H. Vogt

It is with extreme regret that the death of John H. Vogt, which occurred on April 13, is recorded, for Mr. Vogt had been a member of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS since 1925.

Mr. Vogt was associate mechanical engineer of the Division of Industrial Hygiene, State of New York Department of Labor, New York City, and in 1917 instituted the program of departmental examination of plans for industrial ventilation systems. A life-long resident of Brooklyn, N. Y., where he was born October 25, 1873, he was graduated from Adelphi College and later received a B.S. degree in chemistry from Cooper Union. From 1900 to 1906 he was with Vogt & Bros. Manufacturing Co., Brooklyn, and then served as sanitary engineer for two years in the New York State Board of Health, entering the service of the State Department of Labor in October, 1908. In 1911, Mr. Vogt was assigned as a chemical and ventilation engineer to the Factory Investigation Commission created as a result of the Triangle Waist Co. fire, and in 1917, he became chemical engineer in charge of the Division of Industrial Hygiene which was then a part of the Bureau of Inspection.

Surviving Mr. Vogt are his wife, Mrs. John Vogt of Brooklyn, and his son, Harrold Vogt, of Woodhaven, L. I., and a sister, Mrs. Carrie Hurley of Brooklyn, to whom the Officers and Council of the Society express their sincere sympathy.

CANDIDATES FOR MEMBERSHIP

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 27 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge the members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by October 15, 1937, these candidates will be ballotted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	REFERENCES	
	Proposers	*Seconders*
ALLAIRE, LUCIEN, Htg. & Air Cond. Engr., Michel Chouinard, Ltd., Montreal, Que., Can.	F. J. Madely F. G. Phipps, Jr.	C. W. Johnson G. L. Wiggs
BERNERT, L. A., Mgr. Htg. & Air Cond. Dept., The Maag Co., Milwaukee, Wis.	C. H. Randolph J. H. Volk	Ernest Szekely H. C. Frentzel
CAPPS, E. L., Sales Engr., Tidewater Elec. Corp., Norfolk, Va.	Andre Merle H. W. Fiedler	A. F. Hinrichsen A. R. Dowd (*Non-Member*)
EISELE, L. G., Secy., Eisele Automatic Htg. Co., Iron Mountain, Mich.	E. N. Bowles M. C. Kincaide	William Kelly (*Non-Member*) F. E. Parmalee (*Non-Member*)
FALK, D. S., Sales Engr., The Trane Co., Detroit, Mich.	R. L. Deppmann L. A. Burch	K. F. Schaarschmidt (*Non-Member*) S. D. Townsend (*Non-Member*)
FREEMAN, E. M., Sales Engr., Canadian Asbestos Co., Ltd., Montreal, Que., Can.	G. L. Wiggs C. W. Johnson	W. U. Hughes Leo Garneau
GAUSEWITZ, W. H., Owner & Mgr., Conditionedaire, Inc., Minneapolis, Minn.	H. M. Betts A. B. Algren	C. E. Lund F. B. Rowley
GRIEVES, T. R., Br. Mgr., U. S. Radiator Corp., Buffalo, N. Y. (*Reinstatement*)	B. C. Candee P. S. Hedley	J. J. Landers M. C. Beman
HAMLIN, J. B., Jr., Htg. Engr., Crane Co., Savannah, Ga.	E. R. Foss C. J. Sterme-	F. W. Armstrong, Jr. M. C. Gillett

CANDIDATES

JAMES, J. W., Tech. Asst., A.S.H.V.E., New York, N. Y. (*Advancement*)

KEMERY, W. E., JR., Member of Firm, A. E. Doyle & Assoc. Archts., Portland, Ore.

MARTIN, R. H., Chief Engr., Treadwell Engrg. Co., Los Angeles, Calif.

MAXWELL, R. S., Br. Mgr., Bennett & Wright, Ltd., London, Ont., Can.

MILLER, GLEN, Htg. & Vtg. Engr., So. Counties Gas Co., Los Angeles, Calif.

MYLER, W. M., Jr., Mgr. Space Htg. Engrg. Dept., Surface Combustion Corp., Columbus, Ohio

PARKS, C. E., Dist. Mgr., Ilg Elec. Vtg. Co., Pittsburgh, Pa.

PERSSON, N. B., Design Engr., Delco-Frigidaire Cond. Div., St. Paul, Minn.

PFRIEM, P. G., Sales Engr., The Knapp Supply Co., Muncie, Ind.

ROY, A. C., Dist. Sales Mgr., Hoffman Specialty Co., New York, N. Y.

SCHECHTER, J. E., Sales Engr., Barker Bros., Los Angeles, Calif.

SCHREIBER, H. W., Sales, Johnson Service Co., Milwaukee, Wis.

SCHULEIN, E. H., Engr., Birchogkrogboe, Copenhagen, Denmark

SHARP, J. R., Htg. & Air Cond. Repr., Public Service Elec. & Gas Co., Haworth, N. J.

SILBERSTEIN, B. G., Sales Mgr., Ilg Elec. Vtg. Co., Cincinnati, Ohio

TANGER, O. C. F., Director, N. V. Technische Handelsmaatschappij, Arnhem, Netherlands

WRIGHTSON, W. T., Eastern Mgr., Garden City Fan Co., New York, N. Y.

YERKES, W. L., Engr., Carrier Corp., Philadelphia, Pa.

REFERENCES

	Proposers	*Seconders*
JAMES	G. L. Larson L. A. Harding	John Howatt . H. Walker
KEMERY	J. D. Kroeker S. D. Peterson	Lincoln Bouillon A. D. Leach (*N.D.H.A.*)
MARTIN	L. H. Polderman H. M. Hendrickson	W. E. Barnum, Jr. N. W. Berglund
MAXWELL	M. W. Shears H. D. Henion	A. J. Dickey Ernest Fox
MILLER	J. F. Park E. H. Kendall	H. B. Lauer Harrold English
MYLER	R. A. Sherman J. F. McIntire	R. F. Connell W. A. Russell
PARKS	F. C. McIntosh G. P. Ellis	H. A. Beighel A. F. Nass
PERSSON	Albert Buenger A. R. MacMillan	L. C. Gross R. W. Otto (*Non-Member*)
PFRIEM	J. E. Maynard C. F. Price	W. B. Cooper D. B. Poling
ROY	C. V. Haynes J. K. Peacock	E. N. Sanbern C. W. Stewart
SCHECHTER	E. H. Kendall Harrold English	A. J. Hess H. B. Lauer
SCHREIBER	H. W. Ellis C. H. Randolph	J. H. Volk Ernest Szekely
SCHULEIN	L. O. Birch (*Non-Member*) K. O. Lund (*Non-Member*)	S. Soeberg-Andersen (*Non-Member*) Th. Helleberg (*Non-Member*)
SHARP	A. A. Adler H. P. Morehouse	J. C. Fitts M. C. Giannini
SILBERSTEIN	J. M. Frank A. G. Sutcliffe	H. E. Sproull I. B. Helburn
TANGER	H. H. Wex (*Non-Member*) Joseph Tyssen (*Non-Member*)	A. Franse (*Non-Member*) J. J. de Froe (*Non-Member*)
WRIGHTSON	C. S. Pabst W. E. Heibel	Arthur Ritter Harry Baker
YERKES	W. A. Bornemann H. P. Gant	A. P. Shanklin M. E. Barnard

Candidates Elected

In the past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

MEMBERS

ANAYA, MARVIN, Mech. Designer, Bureau of Engrg., City Hall, San Francisco, Calif.

DAUBER, O. W., Consulting Engr., Chicago, Ill.

DAVEY, G. I., Consulting Engr., Haskins & Davey, Sydney, Australia.

GAYNOR, JAMES, Mech. Engr., G. M. Simonson, San Francisco, Calif.

HUBBARD, N. B., Consulting Engr., Hubbard & Wagschal, Detroit, Mich. (*Reinstatement*)

JACKES, H. D., Sales Mgr., Aerofin Corp., New York, N. Y. (*Reinstatement*)

KENNEY, T. W., Sales Mgr., Jas. P. Marsh Corp., New York, N. Y.

LINEBAUGH, J. E., Chief Engr., Frigidaire, London, England.

MCCLAIN, C. H., Htg. & Air Cond. Engr., Upper Darby Plbg. & Htg. Co., Inc., Upper Darby, Pa.

SHERMAN, W. P., Commercial Div. Engr., York Ice Mach. Co., Decatur, Ga.

TAPLEY, M. S., Htg. & Air Cond. Engr., Rudge & Guenzel Co., Lincoln, Nebr.

TAZE, E. H., Sales Engr., American Blower Corp., New York, N. Y.

WILLNER, IRA, Pres., Willner Htg. Co., Inc., New York, N. Y.

ASSOCIATES

ELLIOTT, IRWIN, Chief Engr., Universal Oven Co., New York, N. Y.

FANSLER, P. E., Editor, Air Conditioning Combined with Oil Heat, New York, N. Y. (*Reinstatement*)

HALLECK, L. P., Vice-Pres. & Sales Mgr., The Allen Corp., Detroit, Mich.

HUTCHINSON, F. W., Mech. Engr., Cal. & Hawaiian Sugar Ref. Corp., Ltd., Berkeley, Calif. (*Advancement*)

MCCARTHY, J. J., Engr., Providence School Dept., Providence, R. I.

RANDALL, R. D., Sales Repr., D. T. Randall & Co., Detroit, Mich. (*Reinstatement*)

ROGERS, R. C., House Htg. Engr., Community Natural Gas Co., Bryan, Texas.

WAGNER, J. G., 1st Lt., Civilian Conservation Corp., Trenton, N. J.

JUNIORS

DONELSON, W. N., Htg. Engr., T. J. Conners, Inc., Cincinnati, Ohio.

ELBERT, B. F., Sales Engr., Airtemp Div., Sidles Co., Lincoln, Nebr.

FERRARINI, JOSEPH, Testing Engr., Wash. Gas Lt. Co., Washington, D. C.

SHAPIRO, M. M., Asst. Br. Mgr., Airtemp Div., Sidles Co., Lincoln, Nebr.

SPOERR, F. F., Air Cond. Engr., Carrier Dept., W. L. Thompson, Inc., Boston, Mass.

TAYLOR, T. E., Air Cond. Engr., Control Equip. Co., Portland, Ore.

WHITE, E. D., Engr., Minneapolis-Honeywell Reg. Co., Cleveland, Ohio.

Booklets, Reports and Papers

Air Conditioning for Food Plants

Professor James Holt of the mechanical engineering department of M. I. T. spoke on air conditioning for food plants at the Food Technology Conference at the Massachusetts Institute of Technology last month. Following is an abstract of his paper:

During these days of mass production and keen competition it is essential that the manufacturer of a food product, when he has once satisfied the taste of the public, be able to produce the same article from day to day not only in appearance but in taste and quality or he will soon lose his fickle customers. The manufacturer is also interested in keeping his costs of handling at a minimum with a minimum of waste due to spoilage.

While every food product is more or less of a special problem there are many problems in common that can be solved or improved by the use of conditioned air. Air conditioning finds its greatest application in those plants where the food stuffs are in contact with air during the manufacturing process. In the various food industries, air conditioning is applied for one or more of several reasons.

1. To control the temperature of the product while in storage or during the various stages of manufacture to prevent spoilage or loss of desirable qualities such as appearance, taste, etc.
2. Since most food stuffs are hygroscopic and hence take in or give off moisture until in equilibrium with the surrounding air, it is important to control the moisture content in order to either maintain as nearly as possible the original moisture to prevent loss of weight, or to dry the product during the various stages of manufacture, as required.
3. To clean the air coming in contact with the product.
4. To produce a comfortable and healthful atmosphere in the factory for the benefit of the employees.
5. In the retail trade for the benefit of the customers.

The heat and moisture content of the food stuff or enclosure where it is processed, is seldom or ever constant but in a continual state of flux. Where air conditioning can be applied, it is the function of the air to remove or supply heat and moisture at the proper rate to maintain temperature and moisture content at an optimum.

By far the greatest number of problems involve the removal of heat and maintenance or removal of moisture, hence subsequent remarks will be confined to this type of problem.

The rate at which sensible heat and moisture with its associated latent heat are removed is dependent upon the temperature, humidity and motion of the air coming in contact with the product. Since the air must rise in temperature to pick up sensible heat and rise in moisture content to pick up moisture and latent heat, the permissible rise in temperature or change in moisture content, i. e., absolute humidity, whichever is the controlling factor, then determines the volume of air which must be supplied to an enclosure. This volume, together with the volume of the space to be conditioned and the method for distributing the air in the space, determines the air motion which will prevail. Careful design of the distribution system is very essential to control the air motion over the product at the proper rate.

An air conditioning system is only as good as its distribution system and to obtain good distribution is one of the most difficult problems of the engineer to insure that the temperature, humidity and air motion in every part of the enclosure shall be the same within the permissible limits of variation.

The food technologists and engineers throughout the world have, through their researches, determined the optimum temperatures, humidities, and air motions for storing and processing many of our food stuffs. Unfortunately, the optimum conditions are difficult and sometimes impractical of accomplishment from an engineering point of view and a compromise must be made in commercial practice.

As an example, with meat in cooler storage the loss of weight at 32 degrees is practically three times as great at 85 per cent relative humidity as at 95 per cent relative humidity and approximately doubled at 10 fpm air movement as compared to still air. Loss of weight must be checked, not only for economic reasons, but on account of loss of color, flavor and tenderness at the surface. On the other hand, for high humidities above 90 or 95 per cent spoilage due to bacterial action is apt to predominate due to moisture precipitating on the meat when fluctuations of temperature in the room brings the meat below the dewpoint temperature of the air coming in contact with it. Below 90 per cent relative humidity and fairly constant temperature the spoilage is predominantly due to mold. For relative humidities below 85 per cent serious loss of weight occurs. As a compromise, commercial practice generally accepts 85 to 90 per cent as the optimum humidity range.

The possible limits of variation in temperature and humidity have an important bearing on the design and control of an air conditioning system.

Effect of Air Conditioning Industry on Distribution

International tension will be reduced in the future through the widespread use of air conditioning in tapping untouched supplies of raw materials necessary for maintaining the "balance of power" between nations, L. R. Boulware, vice-president and general manager of Carrier Corp., Newark, N. J., predicted last month before the ninth Boston Conference on Distribution.

Mr. Boulware said that air conditioning's part in opening up heat-and-humidity-sealed gold and copper mines already had proved a factor in "world economy and the world struggle for power, both of which have a direct effect upon the distribution problems in any given country."

"For instance," he pointed out, "air conditioning is aiding the mining of gold in South Africa today over 8000 ft below the surface—this being over 2000 ft below the point where human life and effort would be possible without air conditioning. Deep gold mines are similarly equipped in Brazil, and others are in contemplation.

"The effect of air conditioning on the acceleration of the mining of gold is a very marked factor in the growing monetary problem of the world, the difficulties between nations and the balance of power between nations.

"In this country, the first copper mine has just been air conditioned to permit going down profitably to some lower veins that could not otherwise be even reached.

"In a foreign country now very much in the world news, the possibilities of air conditioning their old coal mines are being checked, and if it can be done successfully, the military experts of the country feel it will be almost the final answer to the preparation against a potential aggressor that has been looming on the horizon now more seriously with each month."

In tracing the effect of air conditioning on distribution, Mr. Boulware named four other effects—on goods during their manufacture, transportation, display, sale and use; on the distribution personnel; on the buyer; and on the buying power of the public.

He noted that in textile manufacturing, particularly rayon, air conditioning was practically indispensable, while many fruits and meats are being transported in air conditioned trains and ships.

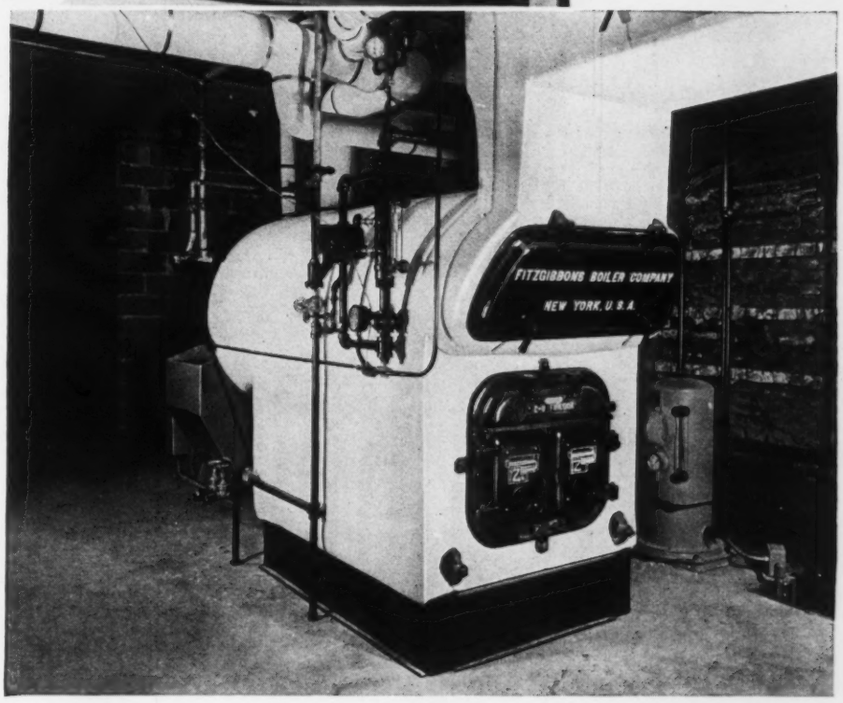
Turning to personnel relationships, Mr. Boulware said that both the employee and the employer could benefit from clean, healthful, comfortable air. Decisions, he said, would be made

(*Continued on page* 114, *back section*)

Disused market building becomes an ideal community center

Transformation scene! Middletown, in Dauphin County, Pa., buys in neglected stone market house and with the able aid of Architect Wm. Lynch Murray, turns it into a fine Borough Hall and Community Building, housing a spacious auditorium and gymnasium, recreation rooms, and certain borough offices.

Congratulations to Middletown for the vision and judgment of its borough officers in carrying through this project. Particularly as it provides for



HEAT AND HOT WATER SUPPLY BY THE

FITZGIBBONS Z-U

STEEL BOILER (*Stoker-fired*)

Notice the photo of the heating installation. A beautifully clean job throughout, installed by Fuel Savers, Inc., Harrisburg, Pa. A difficult job, too, as the chimney location required a boiler with front smoke outlet, while the coal bin location arbitrarily placed the anthracite stoker at the rear of the boiler. The Fitzgibbons Z-U, however, met these conditions perfectly, while permitting easy removal of ash and unobstructed access to flues for cleaning. Hot water supply for all purposes is provided *without a storage tank,* by the Fitzgibbons Tanksaver, a submerged copper coil, built integrally into the boiler.

As shown in this installation, the adaptability of the Fitzgibbons Z-U Steel Boiler is equalled only by its fuel-saving efficiency.

Write—Today—for the "Z-U" Catalog.

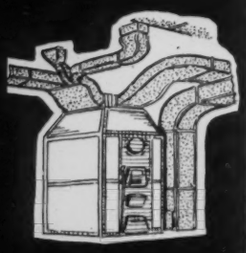
FITZGIBBONS BOILER-AIR CONDITIONERS

Fitzgibbons Boiler Company, Inc.

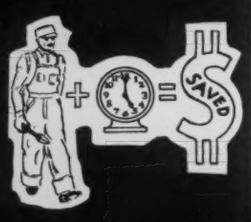
General Offices: ARCHITECTS BLDG., 101 PARK AVE., NEW YORK, N. Y.

Works: OSWEGO, N. Y. • ***Branches and Representatives in Principal Cities***

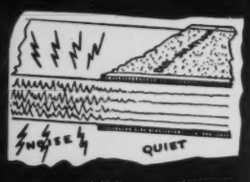
PERFECT INSULATION



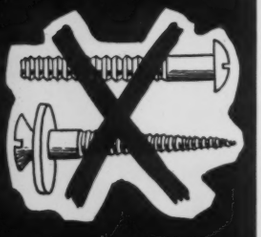
ABSOLUTE FLEXIBILITY



LABOR SAVING



SOUND ABSORPTION



NO SCREWS, LUGS, BOLTS OR WIRE

UNIT PACKAGE — NOTHING ELSE TO BUY

ASBESTOS PROTECTED DUX-SULATION

Ducts insulated with ASBESTOS PROTECTED DUX-SULATION, are safe! Even the finishing tape that assists in application, covers seams, joints and beautifies the appearance has been ASBESTOS PROTECTED.

To these features again add the high insulating efficiency, the high sound absorption, its remarkable flexibility, easy application, moisture-proofness and the fact that it will not rot, chip, crack or deteriorate and you have in DUX-SULATION a most desirable, economical and efficient duct insulation for any air conditioning job.

DUX-SULATION comes complete—nothing else to buy. Its application entirely eliminates the use of lugs, screws, bolts or wire. It will save money in material cost as well as applying time. Investigate DUX-SULATION for your next duct insulation job.

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GRANT WILSON INC

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(*Continued from page* 638, *front section*)

better and more "eagerly and confidently carried out by associates and subordinates."

"At a time when employer-employee relations are being confused by the clamorings of those who seek the favor of many through their contention that all employers indiscriminately are of evil intent, it is being found profitable for each employee—whether he have a grievance or research information to impart—to feel that he has a patient, tolerant and sympathetic hearing by an executive who is calm and of even temper, who in turn can impose a decision that will be accepted and carried out by the employee with the same confidence in its soundness and fairness as that with which it is rendered."

Of the buyer-seller relationships, Mr. Boulware said: "Air conditioning brings the seller a happy, buoyant grateful buyer at all seasons. . . . If air conditioning succeeds in diminishing the summer slump, as it now gives every promise of doing, its effect on employment, on buying power, on selling cost, on the efficiency of the distribution personnel needs no further elaboration here."

The buying power of the public would be greater, he explained, through income and employment being spread over all seasons, through more efficient use of facilities, through more energetic and effective personnel, all resulting in a lower selling cost, a bigger value and a higher standard of living from any given number of man hours per week or year.

Report on Explosion Involving Refrigeration Equipment

The report of the Underwriters' Laboratories, Inc., entitled "Explosion at Mayfair Grill," and dated Feb. 15, 1937, is the result of an investigation arranged for and financed by Kinetic Chemicals, Inc., to obtain reliable information as to the cause of this explosion which occurred in July of 1935. It includes a description of the equipment involved and a discussion of the procedure followed in conducting the leakage test prior to the explosion, a general description of the damage done, and a record of explosion tests conducted to obtain data relating to the cause of the accident. In these tests mixtures of oil and oxygen, solder paste and oxygen, and "Freon-12" and oxygen were included.

The evidence indicates that at the time of the explosion oxygen was being employed in testing for a leak in the refrigeration system, parts of which had been heated. It is noted from the data of the explosion tests conducted, that in the oxygen-oil tests (in which the maximum temperature to which the explosion vessel was heated was of a lower order than that employed in soldering operations), explosions of the oxygen-oil mixtures resulted. It is shown that the "Freon-12" was confined to the receiver at the time of the explosion and that the receiver was not distorted or ruptured. Furthermore, it is shown that if "Freon-12" were present in the refrigeration system, it would not even in the presence of oxygen be capable of developing a sudden pressure or explode when exposed to heat and sparks.

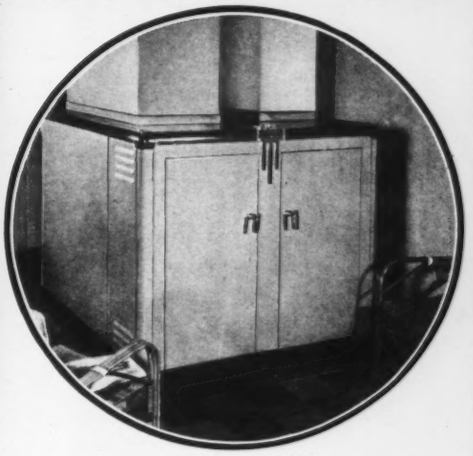
It appears from the foregoing, it is concluded, that the explosion in the refrigeration equipment was caused by the heating of oxygen and oil under pressure.

Fire Underwriters Offer Suggestions on Installation of Air Conditioning

A number of instances have arisen recently where through failure to comply with important provisions for fire protection, installers of air conditioning equipment have found it necessary to take down and replace certain portions, or make changes in systems after they have been completed, in order to avoid penalties in the fire insurance rate, according to the National Board of Fire Underwriters. Such difficulties could be avoided by having the plans for air conditioning equipments checked over by the local fire insurance inspection organization before installa-

The Delco Conditionair *Modernizes* Home Heating!

Today, the American family wants the healthful benefits of *Winter Air Conditioning*



The new Delco Conditionair heats, humidifies, filters and circulates air, at an initial cost no greater than some types of Automatic Heating alone. When installed with properly sized ducts and high wall registers it provides the cheapest way to add summer cooling and dehumidifying — now or at a later date. Fired by oil or gas.

Thousands of homes now equipped with this Proved Type *of Winter Air Conditioning*

NOW the old-fashioned heating system, with its parched stale air, gives way to *healthful* Winter Air Conditioning. The new Delco Conditionair warms and moistens the air. It filters out germ carrying dust and pollens. It gives positive air circulation and even room temperatures.

The new Delco Conditionair brings true winter air conditioning to homes costing as little as $5000. It is not a makeshift assembly of fan, spray and furnace. The Delco Conditionair is a thoroughly engineered unit—pioneered, built and backed by General Motors. Exclusive construction features greatly increase economy in operation. And the initial cost is actually less than some types of automatic radiator heating systems.

• • •

The Delco Conditionair is only one of the many heating and air conditioning products of Delco-Frigidaire, the air conditioning division of General Motors . . . Consult Sweet's Catalogue. Or write for more information. Our Consultation service is designed to save engineers time and trouble.

It Pays to Talk to

DELCO-FRIGIDAIRE

The Air Conditioning Division of General Motors

AUTOMATIC HEATING • COOLING • CONDITIONING OF AIR

tion has been started. The inspection organizations give this service without charge.

The installation of air conditioning equipment in buildings protected with automatic sprinklers frequently involves some interference with the effective operation of sprinklers, making necessary the installation of additional sprinkler heads or rearrangement of sprinkler lines. For these reasons it is particularly important that the inspection organizations be consulted on the installation of air conditioning equipment in sprinklered buildings.

The regulations of the National Board of Fire Underwriters for the installation of air conditioning systems cover the features of installation that relate to fire hazard and include such provision as construction of ducts, their arrangement and support, automatic fire doors and dampers, air filters, fan controls, and refrigerant coils in air ducts. Copies of these regulations are obtainable from the National Board of Fire Underwriters, 85 John St., New York, N. Y., 222 W. Adams St., Chicago, Ill., or Merchants Exchange Bldg., San Francisco, Calif. Copies may also be obtained from the offices of local insurance inspection organizations.

Summary of Silicosis Conference

Bulletin No. 13 of the Division of Labor Standards, U. S. Department of Labor, presents the summary reports submitted to the Secretary of Labor by the committees of the National Silicosis Conference, February 3, 1937. These committees were on prevention through medical control; through engineering control; economic, legal and insurance aspects of the problem; and regulatory and administrative phases of silicosis. A five-page list of references pertinent to engineering control is included, and the complete personnel of the committees is given.

The work of the Conference has been reviewed in some detail in earlier issues of HEATING, PIPING AND AIR CONDITIONING.[1]

[1]See August, 1936, issue, p. 438; March, 1937, page 152 (back section).

The bulletin, however, contains material which has not been generally available, and may be obtained from the Superintendent of Documents, Washington, D. C., for 10c.

Book Reviews

Thermodynamics

["Thermodynamics," by H. A. Everett, Head of Department of Mechanical Engineering, The Pennsylvania State College. 1st ed. 1937. 430 + xiv pp., 6 x 9 in., clothbound. Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, N. Y. Price, $3.75.]

This is a text intended primarily for students in engineering colleges, and it assumes a preceding knowledge of the calculus and a follow-up by the "applicational" courses such as power plants, internal combustion engines, refrigeration, and the like. As the author mentions in his preface, a work of this sort presents little that is new, but consists mainly of the author's method of presenting the classical and neo-classical data.

Chapters are given on energy and the mechanical theory of heat, the mechanical theory applied to gases, fundamentals, gases, the second law of thermodynamics, engines using gases for working fluid, gaseous mixtures, flow of fluids (gases), vapors, flow of vapors, engineering devices using vapors, mixtures of gases and vapors, refrigeration, and general thermodynamic relations. The last mentioned represents to the author "the irreducible minimum with which any student of present-day thermodynamics as applied to engineering problems should be familiar."

This book is very well printed, carefully indexed, and should be useful to the engineer as a reference in addition to serving the student as a text.

NO SMALL MATTER, the additional factor of fire-safety . . . when lining air-conditioning ducts for sound absorption! Bulletins from the National Board of Fire Underwriters report cases where expensive damage was caused by the absence of this protection.

To make sure *your* air-conditioning ducts will never contribute to fire spread, line them with Johns-Manville Airacoustic Sheets. This material has a rate of sound absorption as high as 80% . . . and provides a high degree of fire-safety as well.

Moreover, J-M Airacoustic Sheets provide many other advantages. Permanence, by virtue of their mineral composition . . . resistance to moisture . . . low thermal conductivity . . . light weight . . . and a smooth surface that means low frictional resistance.

For complete details on J-M Airacoustic Sheets, write Johns-Manville, 22 E. 40th St., New York, N. Y.

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AIRACOUSTIC SHEETS
For Duct Lining

Conventions and Expositions

Chicago Exposition of Power and Mechanical Engineering: October 4-9, International Amphitheatre, Chicago, Ill. Under management of the International Exposition Co., Grand Central Palace, New York, N. Y., manager of the biennial National Expositions of Power and Mechanical Engineering, the next of which will be held in New York City December 5-10, 1938.

American Public Health Association: Annual meeting, October 5-8, Hotel Pennsylvania, New York, N. Y. Headquarters Office, 450 7th Ave., New York, N. Y.

Hygiene of Housing Symposium: 9:30 a. m., October 8, North Ballroom, New Yorker Hotel, New York, N. Y. Committee on the Hygiene of Housing, American Public Health Association, 50 W. 50th St., New York, N. Y. Papers to be presented on air conditioning, housing and health, construction methods, sanitary engineering, town planning, safety in the home, and lighting.

American Welding Society: Annual convention, week of October 18, Hotel Traymore, Atlantic City, N. J. Headquarters Office, 33 W. 39th St., New York, N. Y.

Refrigeration Service Engineers' Society: Annual convention and exhibit, November 3-5, Hotel Stevens, Chicago, Ill. Chairman, Herman Goldberg, 9 S. Clinton St., Chicago, Ill.

American Petroleum Institute: Annual meeting, November 9-12, Hotel Stevens, Chicago, Ill. Headquarters Office, 50 W. 50th St., New York, N. Y.

International Acetylene Association: Annual convention, November 10-12, Hotel Tutwiler, Birmingham, Ala. Headquarters Office, 30 E. 42nd St., New York, N. Y.

Chemical Industries Exposition: December 6-11, Grand Central Palace, New York, N. Y.

Drying and Air Conditioning Symposium: December 27-28. University of Pennsylvania, Philadelphia, Pa. Under auspices of the Division of Industrial and Engineering Chemistry, *American Chemical Society.* Symposium Chairman, D. B. Keyes, Department of Chemistry, University of Illinois, Urbana, Ill.

Fifth International Heating and Ventilating Exposition: January 24-28, 1938, Grand Central Palace, New York, N. Y. Manager, Charles F. Roth, International Exposition Co., Grand Central Palace, New York, N. Y.

American Society of Heating and Ventilating Engineers: Annual meeting, fourth week in January, Biltmore Hotel, New York, N. Y. Secretary, A. V. Hutchinson, 51 Madison Ave., New York, N. Y.

National Warm Air Heating and Air Conditioning Association: Winter convention, January 24-26, Roosevelt Hotel, New York, N. Y. Managing Director, Allen W. Williams, 50 W. Broad St., Columbus, Ohio.

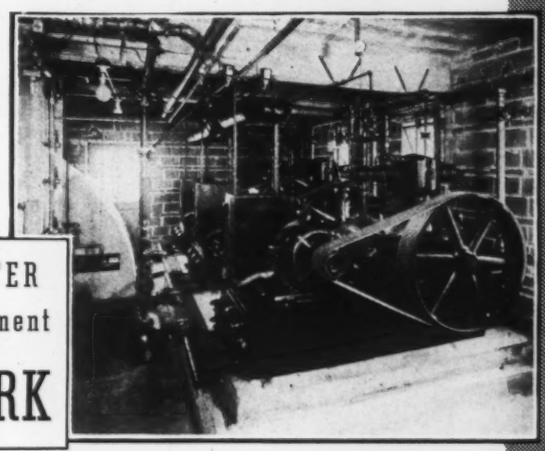
American Society of Refrigerating Engineers: Annual meeting, January 26-28, Roosevelt Hotel, New York, N. Y. Secretary, David L. Fiske, 37 W. 39th St., New York, N. Y.

Schools and Study Courses

The Federation Technical School, 116 E. 16th St., New York, N. Y., announced last month its expanded courses for the coming school year. The fall term began September 27, and registration for the spring semester is scheduled for January 24.

On the program offered by the school's mechanical engineering department are courses on mechanical equipment of buildings, a review for those intending to take the examination for registered architect; heating, ventilating and air conditioning; piping design and layout, which is intended to give to men of limited piping experience a knowledge of general piping applications; and boiler and furnace layout.

Quiet, Vibrationless, Air Conditioning



VILTER Equipment at WORK

in the FIRST WISCONSIN NATIONAL BANK . . .
MILWAUKEE, WISCONSIN

Above—3 - 7x5½ Self - Contained Vilter Freon Units. Total Capacity 75 tons. Installed in Roof Penthouse.

Air Conditioned Cafeteria.

Air Conditioned Accounting Department 174 machines — 300 employees.

Vilter Equipment is "at work" in some of the largest and most famous Air Conditioning and Refrigeration installations in the country. . . . In every instance setting new standards in efficient, quiet, vibrationless, low cost operation.

Vilter engineers have been "Pioneers" in Refrigeration since 1867. . . . And every year in that long history has seen new Vilter achievements,— building for today's inevitable popularity of Refrigeration and Air Conditioning.

Modern engineers have learned that it's wise to specify Vilter Equipment for dependable service in all Refrigeration and Air Conditioning installations.

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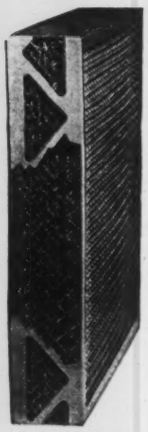
AIR-MAZE FILTER PANELS



-Open end cut-away view

Scientific design combined with precision construction has made AIR-MAZE air filter panels the choice of many leading commercial buildings. Exact and uniform progressions of density in the unique filter element assure *even collection and pyramiding* of all dust, grit and pollens. This means unusual ease of cleaning and *no clogged areas.* Write today for bulletin BPAN-86.

These features will solve your filter problems

- 99.83% air cleaning efficiency.
- Easily cleaned and charged.
- No replacements needed.
- Very low pressure drop.
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See AIR-MAZE in the A. S. H. & V. E. Guide Book

AIR-MAZE CORPORATION
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AIR FILTER PANELS

Equipment Developments

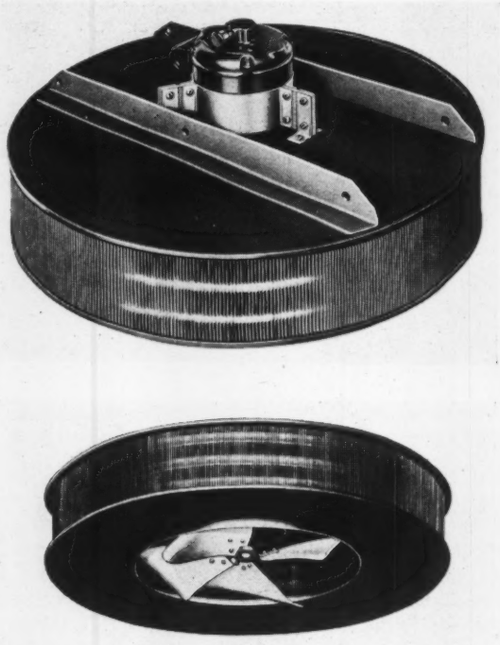
For your convenience in obtaining more information about any of this equipment, see coupon on page 144. Add the new products and companies listed here to your Directory Section which you received in your January, 1937, HEATING, PIPING AND AIR CONDITIONING and thus keep your records of sources of supply up to date throughout the year . . . Single asterisk (*) indicates equipment not listed in Directory Section; double asterisk (**) equipment and manufacturer not listed.

Projection Type Unit Heater Announced

No. 1308—The recent development of a new projection type unit heater attacks the problem of heating large spaces and especially buildings of considerable heights and preventing excessive temperatures at the ceiling when the room temperatures at the breathing, or occupied zone, are at a desired level. This ceiling mounted space heater is a high velocity unit of the propeller type which, through its inherent operating characteristics, provides a form of vertical air stream for distant projection of the warm air.

It comprises a two row circular coil mounted between two circular plates, the upper plate being the supporting backbone of the unit, and the lower providing the orifice for the fan. The illustrations show top and under views.

The warm upper air is *drawn through* the circular coil at a low velocity and then projected straight downward to the floor



by the four blade propeller fan of new design. As this air stream enlarges in the manner of a flood light, its velocity decreases, so that when the air stream reaches the floor there are no noticeable drafts, according to the maker. The air stream, in its downward course, also induces a large volume of air which results in a gradual temperature drop.

In the simple circular structure lie some of the unique features of this space heater, it is said. The circular coil can take care of itself as far as normal contraction and expansion go, and for the same amount of heating surface it requires only ¼ the number of joints necessary in a rectangular coil. The motor is mounted on a three point resilient construction which prevents motor noises from being telegraphed to the metal parts of the unit, and keeps the motor out of the air stream.—Trane Co., La Crosse, Wis.

ANNOUNCEMENT

AEROFIN

Heat-Exchange Surface

Aerofin Corporation announces the acquisition of enlarged manufacturing facilities at Syracuse, New York, from which point we shall continue to serve our customers with light-weight, standardized heat exchange surface for heating and cooling. The general sales and executive offices of Aerofin Corporation are now located in the above named city.

This move is in line with an expansion program growing out of the increased demand for Aerofin equipment and reflects the confidence imposed in Aerofin by consulting engineers, architects, heating and refrigeration contractors throughout the country. Aerofin has recently established new branch sales and engineering offices at Dallas and Atlanta, making a total of six strategically located points from which experienced engineering service and technical assistance is available.

With the heating, cooling and air conditioning industries pressing forward on all fronts, you will need the sound, reliable engineering service that Aerofin offers. Take a leaf from the experience of thousands of technicians in these fields who specify Aerofin heat exchange surface. Write today for complete catalogue data and engineering information.

AEROFIN is sold only by Manufacturers of Nationally Advertised Fan System Apparatus. — List upon Request

AEROFIN CORPORATION
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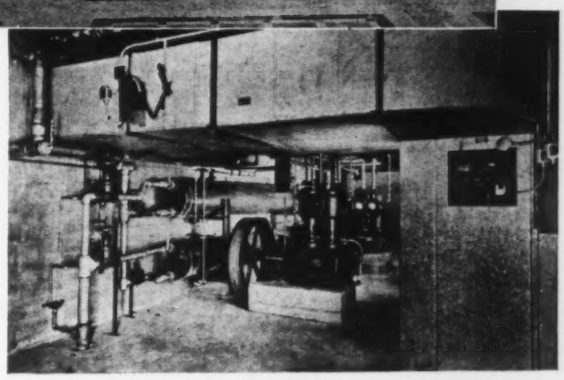
Chicago • Detroit • New York • Philadelphia • Dallas • Atlanta

AIR CONDITIONING for PUBLIC COMFORT and BUSINESS PROFIT



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CARBONDALE engineers . . . backed by an organization with 37 years of experience in the air conditioning field . . . will be glad to explain the new and better Carbondale features.

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WORTHINGTON PUMP AND MACHINERY CORPORATION
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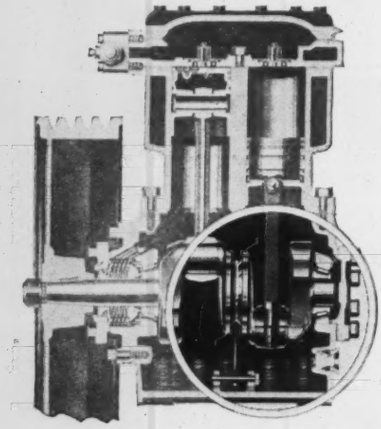
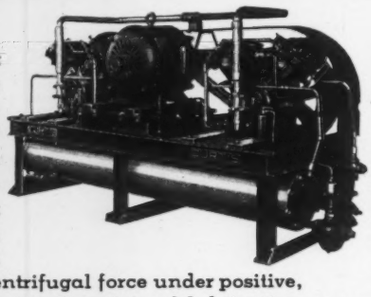
CA7-41 Offices and Representatives in Principal Cities

CARBONDALE

CURTIS
Condensing Units



"CENTRO-RING" LUBRICATION—
—only
CURTIS COMPRESSORS
have it



THERE'S just one moving part in Curtis "Centro-Ring" lubrication—a simple, free running ring that picks up oil from the crankcase and distributes it by centrifugal force under positive, uniform pressure to all points of lubrication—no gears—no plungers—nothing to get out of order or require service.

Engineering superiorities of this kind have built the Curtis reputation for reliability, long operating life and low cost of upkeep.

The Curtis line contains 41 air-cooled units, from 1/6 HP to 5 HP, inc., and 45 water-cooled units from 1/3 HP to 30 HP — a size and type to balance most any installation you might make. Curtis has built condensing units for 15 years and has made engineering equipment for 82 years — a record of success that in itself is sufficient warranty of the high-quality of Curtis units of today.

CURTIS Engineering Refinements

- Centro-Ring — one piece, positive pressure lubrication
- Timken Tapered Roller Bearings
- V-type radial compressor
- Water-jacketed compressor heads and cylinders
- Built-in oil separator with automatic return
- Drop forged, heat treated crankshafts and rods
- Balanced syphon, bellows seal
- Automatic water valves

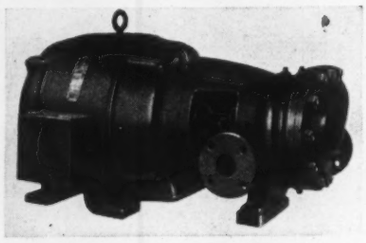
Represented in Canada by
Canadian Curtis Refrigeration Co., Ltd.
20 George St., Hamilton, Ont., Can.

CURTIS REFRIGERATING MACHINE CO.

"Builders of Condensing Units since 1922"
1950 Kienlen Ave., St. Louis, U. S. A.

Pump and Motor Unit Operates Against 500 Ft Head

No. 1309—A two stage "built-together" pump (pump and motor built together) has been developed to operate against heads up to 500 ft—higher than could be handled by a single stage unit. In many applications it offers a less expensive alternative for multi-stage and split case pumps, and its compactness and sturdiness qualify it for portable and semi-portable as well as stationary service, says the maker.



It is adapted for all classes of general pumping service with liquids low in viscosity and free from excessive foreign matter. Because of its compact design, the pump is advantageous where space is limited. No special foundation is required, as the pump is complete in itself and can be mounted in any convenient horizontal, vertical or angular position.

Entirely designed and built in one factory, the unit consists essentially of a two stage centrifugal pump, with enclosed bronze impellers, mounted directly on the shaft of a splash proof motor. Two ball bearings take the radial and unbalanced thrust loads. Impellers for the two stages are placed back to back, compensating thrust. Improved hydraulic design is attained by placing the first stage unit next to the motor and the second stage on the outside, simplifying the cross-over passage and placing the stuffing box under suction instead of pressure. A mounting leg under the pump end gives the unit added stability.—Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.

Valves Handle Pulp Stock, Other Fluids

No. 1310—New valves designed especially for controlling the flow of pulp stock in pulp and paper mills are also applicable to services in other industries where manufacturing processes require the handling of fibrous solids suspended in water or similar fluids. They are made for low pressure service—not over 60 lb water, such as prevails on pulp lines.

This new line is a result of several years of research and experimentation including operation in actual field service. The body is made in two halves, bolted together, with cleanout provided on the bottom. Each valve body has six threaded and plugged openings, two on each side and two on the bottom, so that when necessary a water supply pipe can be connected to these openings to flush the inside of the valve and the pipe line.

The valves are made in sizes 4, 6, 8, 10, 12, 14 and 16 in. in both outside screw, rising stem and quick opening types; flanged, all iron or brass trimmed. Face to face dimensions are the same as the maker's standard iron body wedge gate valve, thus permitting easy interchangeability without the necessity of expensive pipe alterations.—Crane Co., 836 S. Michigan Ave., Chicago, Ill.

Offers New Electric Heater

No. 1311—Illustrated is a new addition to an extensive line of electric air heaters. It consists of "Chromalox Koilfin" heaters mounted in a cylindrical housing. The motor driving the fan is in the center of the heater assembly and is cooled by the fan in addition to being protected from radiant heat by baffles.

Available ratings vary from 2 to 20 kw for operation on either 115 or 230 volts, single or three phase. Air velocity through the heaters is between 800 and 900 fpm and temperature rise between 20 and 70 F can be obtained dependent upon the size heater used.

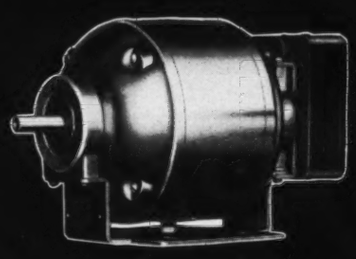
Base of the heater is adjustable for either wall mounting or portable use. For portable use rubber pads are provided on the base.

BALDOR BUILDS *Better Motors*

BALDOR

Gimbal-Cushioned

MOTORS



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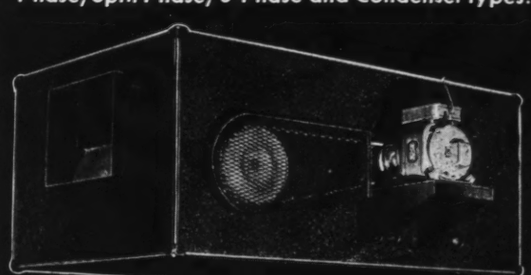
XTRA QUIET

Baldor Gimbal-mounted Motors are scientifically rubber cushioned, and are recommended for all sizes and types of Air Conditioning units and other applications where extreme quietness is necessary. Fractional h. p. up to 2 h. p. Single Phase, Split Phase, 3-Phase and Condenser types.



Complete, self-contained Air Conditioning unit manufactured by YOUNG RADIATOR CO., Racine, Wisc. Equipped with Baldor Motor.

BALDOR ELECTRIC COMPANY

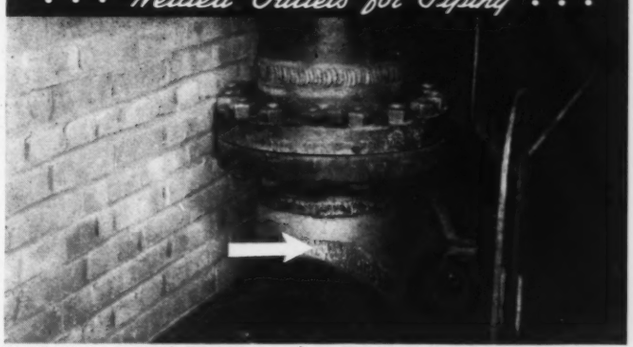
4300 DUNCAN AVE. - - - - - ST. LOUIS, MO.

BALDOR

A BETTER MOTOR

WELDOLETS · THREDOLETS

. . . Welded Outlets for Piping . . .



WHY WRECK A BUILDING TO MAKE A PIPE CONNECTION?

1. WeldOlets and ThredOlets are easily installed. Simply select the position of the outlet, mark center lines and tack the fitting into position.

2. Then weld by oxy-acetylene or electric-arc method. A leak-proof joint of full pipe strength is obtained.

3. On 2" outlets or larger, the button is removed after installation. A full inspection of the inside of the joint is possible when WheldOlets or ThredOlets are used.

4. A simple Vee weld is used for attaching the branch when WeldOlets are used. If ThredOlets are used, the branch is screwed into position.

SOUNDS silly, doesn't it? Yet if anything but a WeldOlet had been used in making the branch pipe take-off shown above, it would have been necessary to tear a hole in the wall of the building.

Instead, the 12" main pipe remained in position. No cutting - no threading - no fitting of the main or branch pipe was necessary. No templets were used. The position of the outlet was selected and the WeldOlet welded into place. The hole was cut in the main pipe after the WeldOlet was installed. An absolutely leak-proof joint was obtained.

Not every job possesses the economy possibilities of this one - but Bonney WeldOlets and ThredOlets cost no more to buy and less to install than any other type of pipe fitting. They're available for all standard pipe sizes and for every piping requirement. For full information sign and mail the coupon below.

The names "WeldOlet" and "ThredOlet" are Bonney trade marks registered in the United States Patent Office. Full Patent coverage for designs, principles and construction has been granted in the United States and foreign countries.

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Bulletin WT23 tells How, When, Where and Why to use WeldOlets and ThredOlets. Mail coupon for your copy.

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Sylvania Hotel, Philadelphia, Pa.

HEATING MODERNIZATION CUTS COAL CONSUMPTION

Sylvania Hotel Saves 260 Tons of Coal in First Year with Webster Hylo System

HEATING COMFORT FOR GUESTS

Philadelphia, Pa.—The Sylvania Hotel reduced coal consumption 260 tons in a single heating season as the result of a Webster Heating Modernization Program carried out in the fall of 1935.

This substantial reduction in heating expense was accomplished in a building only 12 years old by equipping 1,000 radiators with Webster Metering Orifices and applying Webster Hylo Variator Control.

The decision to modernize the heating system in this well-known Philadelphia hotel was based not so much on possible economies as on the opportunity to improve heating service.

The effectiveness of the Webster Hylo System in assuring added comfort for guests is shown in the following statement by Ralph Romspert, Chief Engineer of the Sylvania:

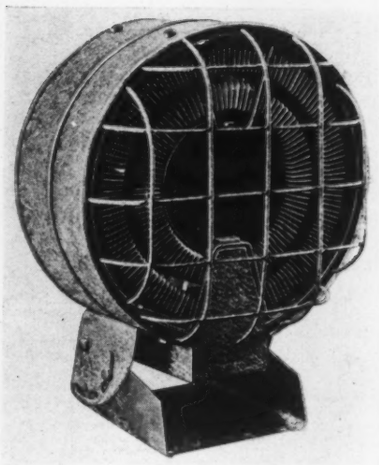
"In two heating seasons, all sections of the Hotel have received steam evenly and rapidly regardless of outdoor weather conditions. Overheating and underheating have been reduced to a minimum."

Before modernization, Webster Engineers estimated that modern heating would save 140 tons of coal per season. During 1935-36, when the degree day load was 17.5 per cent greater than normal, coal savings exceeded the estimate by 86 per cent. For the first five months of the 1936-37 season, when the degree day load was 4.5 per cent greater than normal, coal savings exceeded the conservative estimate by 59 per cent.

The Huffman-Wolfe Co., well-known Philadelphia firm, acted as modernization heating contractors.

These before-and-after facts point the way to maximum comfort and economy in heating new buildings as well as in modernization of existing installations. Consult your architect, engineer or heating contractor. Or address

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Representatives in 60 principal U. S. Cities — Est. 1888



Heating units are protected against overheating, in case of fan failure, by a thermostatic cut-out which is manually reset. Heaters of 2 to 4 kw size, single phase, are provided with a toggle switch, so that the assembly can be used as a fan for cooling. These features make the heater suitable for process work where heated air is needed as well as for heating homes, offices, pumping stations, etc., according to the manufacturer.—Edwin L. Wiegand Co., 7610 Thomas Blvd., Pittsburgh, Pa.

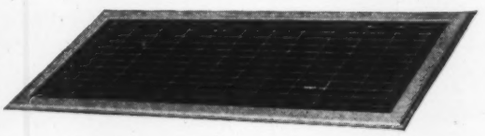
Motors Developed for Deep Well Pumping

No. 1312—Because of the growing demand for deep well pumping equipment, new vertical hollow shaft motors for such service have been developed. Among the improvements embodied are a simplified oiling system for the top (thrust) bearing, a ball type guide bearing, and more attractive appearance.

In addition, the motors afford high full load speed, adequate starting torque, high efficiency, double-end ventilation, and full mechanical protection, says the maker.—General Electric Co., 1 River Rd., Schenectady, N. Y.

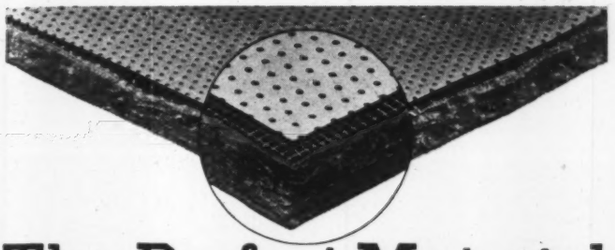
Registers and Intakes Have Interlocking Face

No. 1313—A new design (called "DuraBilt") of floor registers and cold air faces features a steel cross bar constructed face, each cross-joint having a mortised and locked fit. Each cross-member is also locked to frame by a hooked joint. The oblong mesh is well proportioned and creates an effect pleasing to the eye. Air capacity is generous, yet meshes are close enough to exclude French heels and small objects.—Auer Register Co., 3608 Payne Ave., Cleveland, Ohio.

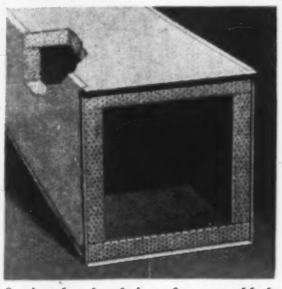


Hammer Lug Forged Steel Unions Announced

No. 1314—New hammer lug unions comprise two distinct lines. (1) forged steel screwed unions with one set of lugs, and (2) forged steel screwed unions with two sets of lugs. Both have been designed for use in piping systems requiring frequent or quick dismantling. A blow with a hammer upon the lug will break the joint without using a wrench.



The Perfect Material *for Absorbing* DUCT NOISES



Sectional and end view of an assembled length of duct lined with Burgess Acousti-Pad for noise suppression.

● For absorbing the roar of ventilating fans, the sound of rushing air, and inter-room duct noises, Burgess Acousti-Pad is the ideal lining. This patented material consists of a sound absorbent blanket (Balsam-Wool) covered with a facing of perforated metal. Although the facing is 10% perforated, nearly 100% of the sound striking the surface passes through the holes and is absorbed.

●ABSORBS NOISE
Acousti-Pad effectively blots up both high and low pitched noises.

●FIRE RESISTANT
The metal surface and chemical treatment make it flameproof.

●ODORLESS
Has no odor in itself. Heat or moisture do not generate odors in it.

●NO RESTRICTION
The hard, smooth surface offers minimum resistance to air flow.

Write for FREE Bulletins

also- for ROOM SILENCING

Acousti-Pad, now available for room ceilings and walls, makes a durable yet attractive absorbent. Write for particulars.

Burgess Battery Company
(Acoustic Division) Dept. H
111 W. Monroe St., Chicago, Ill.

BURGESS ACOUSTI-PAD

For Absorbing Duct Noises in Air Conditioning Systems

Licensed under C. F. Burgess Laboratories, Inc., Patents

MACKLANBURG
BRASS & COPPER PRODUCTS, INC.

BRASS, COPPER & BRONZE IN SHEETS, RODS, PLATES AND TUBES
REFRIGERATION SUPPLIES ACCESSORIES AND PARTS
R. B. COVERT MANAGER

Revere COPPER BRASS Products

OFFICE AND WAREHOUSE 111 N. W. 23rd PHONE 4-2242
ADDRESS ALL CORRESPONDENCE TO THE COMPANY P. O. BOX 1197
OKLAHOMA CITY

July 27, 1937

Interior of new Refrigeration Supply Store of Macklanburg Brass & Copper Products, Inc., Oklahoma City, Okla.

It is needless to say that Automatic Products is playing a very prominent part in our refrigeration supply business and we are finding an increasing demand for these products every day.

Very truly yours,

MACKLANBURG BRASS AND COPPER PRODUCTS, INC.

Per A. R. Morin

ARM:ZB

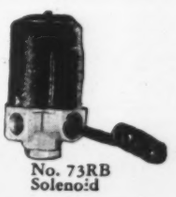
Go to Your Jobber for Your A-P Control . . .

Prominent Refrigeration Jobbers everywhere are realizing the importance of letting A-P Expansion Valves and Solenoids help them to build their Reputation on the solid foundation of dependable service.

A-P Controls on every one of your installations is assurance of dependable operation,— consistent efficiency,— trouble-free performance that guards well YOUR reputation in the fast-moving Refrigeration Industry.

There's no guess work in an A-P Valve. Every one is proven many times to be leak-proof, accurate, durable,— ready for a long life of economical operation on your job.

Progressive jobbers everywhere stock A-P Controls



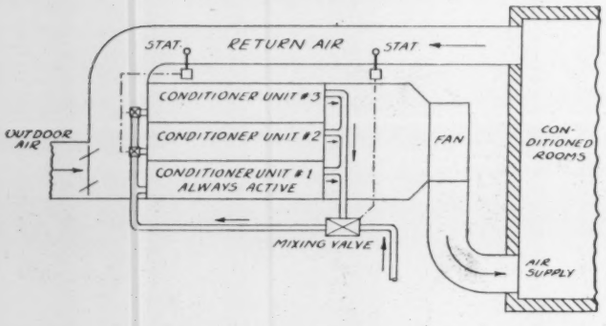
No. 73RB Solenoid

No. 210 Expansion Valve

No. 78 Solenoid

AUTOMATIC PRODUCTS COMPANY
2460 NORTH THIRTY-SECOND STREET
MILWAUKEE • WISCONSIN

A SYSTEM WITH VARIABLE BY-PASSING AND VARIABLE CONDITIONING



IN this System (*) all outside air is dehumidified while treatment of return air depends upon the load.

The air is delivered to the room at a comfortable condition since the cold dehumidified outside air is tempered by the partially treated or untreated return air.

This system is ideal for use where it is desired to pass all air used through the conditioner while still maintaining close regulation by means of variable conditioning.

Any one of the thousands of our licensees' dealers, distributors or salesmen will gladly discuss the engineering features of this system with you. Many variations of this typical layout are possible.

This system is only one of many air conditioning systems (*) described in our booklets, copies of which are available from our licensees.

American Blower Corp.
Detroit, Mich.

Buffalo Forge Co.
Buffalo, N. Y.

Carrier Corp.
Newark, N. J.

Frick Co.
Waynesboro, Pa.

General Electric Co.
Schenectady, N. Y.

J. O. Ross Engineering Corp.
New York, N. Y.

The Cooling & Air Conditioning Corp.
Division of B. F. Sturtevant Co.
Hyde Park, Boston, Mass.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

York Ice Machinery Corp.
York, Pa.

(*) *Auditorium Air Conditioning Systems are covered by many issued patents and pending applications.*

AUDITORIUM CONDITIONING CORPORATION

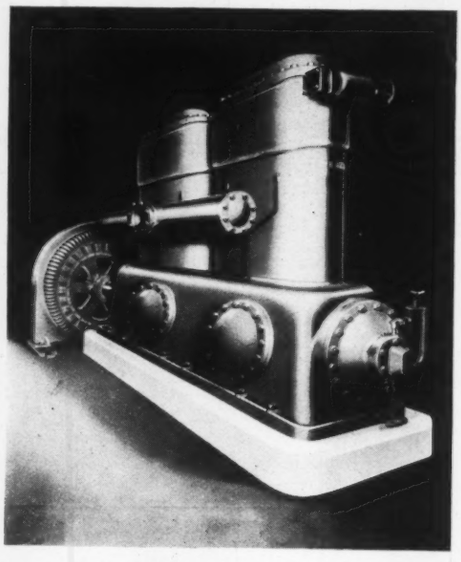
New York Office—17 East 42nd Street . New York

They are especially recommended by the maker for service on hydraulic roll balancing systems in steel mills, where it is often necessary to break a union connection quickly. The lugs add to the convenience in breaking a joint in cramped spaces where there is not sufficient clearance for a wrench. The oil industry has found that such unions save time and labor in field work around the boiler.

The single lug union is made with forged steel tail pieces and thread pieces in sizes 2, 2½, 3 and 4 in. (these parts are of cast steel on the 4 in. size) and have lugs on the union ring. The double lug union is all forged steel, having lugs on both the union ring and the thread piece. It is made in sizes ⅜, ½ and ¾ in.—Crane Co., 836 S. Michigan Ave., Chicago, Ill.

Announces New Ammonia Compressor

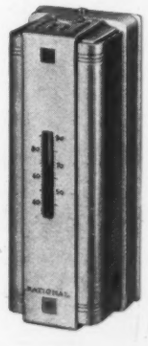
No. 1315—A new high speed, multiple cylinder ammonia compressor has been developed to meet the increasing requirements of small floor space and low head room in applications of 100 tons refrigeration capacity and up. It embodies all the prominent features of the maker's line of vertical single acting compressors and is highly efficient, says the manufacturer. Light weight valves, pressure lubrication throughout, and general design improvements, with higher rotative speeds, have resulted in a reduced initial cost per ton of refrigeration.



The compressor will be built in sizes to furnish from 100 to 800 tons of refrigeration. Although designed for synchronous motor drive, the machine may also be adapted for operation with any type of prime mover.—York Ice Machinery Corp., Roosevelt Ave., York, Pa.

Pneumatic Thermostats Modernized

No. 1316—A change has been announced in the "National" line of pneumatic thermostats—known as "Helmet Sealed." It is a new, modern case designed along the lines of other of the maker's thermostats. This also affects the "National" line of room type humidity controllers.



All moving parts of the thermostat operate in a sealed chamber to guarantee its trouble-free, dependable operation over an indefinite period, free from the contamination of dirt, chemicals, chalk dust, or any foreign substance and free from tampering even to the extent of preventing the disturbing of the operating mechanism by pushing a pencil or any other foreign object through the openings in the case.

IT'S *Your* RESPONSIBILITY TO SELECT THE PIPE

It's a good guess that nine out of every ten jobs are steel pipe jobs in which the selection of the pipe is left to you. Thus, it becomes your responsibility to select pipe that will give your customer full dollar value and at the same time insure profit for you. • That's why many engineers and contractors have discontinued the use of "any steel pipe." They insist on Fretz-Moon Pipe — because it is sound in every respect and because it permits them to use pipe of unusually high quality at no increase in price. • They know, too, that because of the exclusive "continuous process" of manufacture, all uncertainty and guess work is eliminated — and the finished pipe is exceedingly uniform in size, weld, ductility, cleanliness, threading and galvanizing — thus making possible economies in installation. • Ask your jobber for Fretz-Moon Pipe. If he cannot supply you, write us.

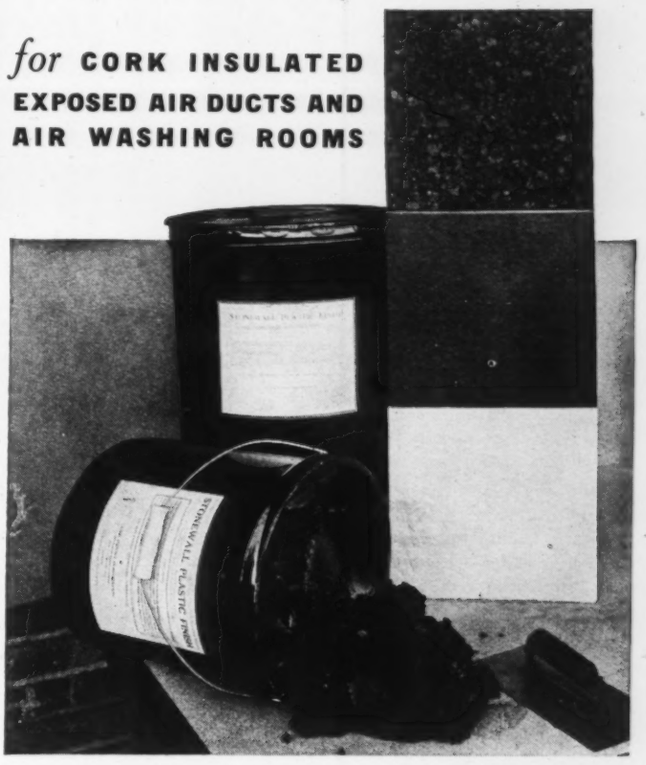
FRETZ-MOON TUBE CO., INC.
BUTLER • PENNA.

TRY FRETZ-MOON PIPE
—AND KNOW THE DIFFERENCE

Increase the efficiency of Air-conditioning insulation with the **EXTRA** *protection of*

STONEWALL FINISHES

for **CORK INSULATED EXPOSED AIR DUCTS AND AIR WASHING ROOMS**



FOR many years Novoid Corkboard Insulation has been a prominent factor in increasing the efficiency of air conditioning equipment. Now it is possible to secure even greater efficiency and lower operating costs by surfacing the insulation with a protective coating of STONEWALL FINISHES.

Applied cold as received, STONEWALL FINISHES form a smooth, even coating which is impervious to both air and moisture. They are easily applied to curved surfaces and may be readily painted with Novoid White Cold Storage Paint or Novoid Aluminum Paint. STONEWALL FINISHES are ideal for surfacing insulated, exposed cold air ducts and air washing rooms. Three different finishes are available for a wide variety of uses: Stonewall Plastic Finish, Stonewall Emulsion Finish, and Stonewall Emulsion. For descriptive literature and full information, call the nearest branch or write Cork Import Corporation, 330 West 42nd Street, New York City.

CORK IMPORT CORPORATION
330 WEST 42nd STREET, NEW YORK CITY

BRANCH OFFICES: Chicago, 400 West Madison Street • Boston, 248 Boylston Street • Philadelphia, 1524 Chestnut Street.

The thermostatic element of "Ebonite" has been retained. Overall size has been reduced, and the simplified adjustment features of the previous model have been retained. The thermometer has been recessed for protection. The temperature range has been changed from 35-82 F to 46-90 F.—Minneapolis-Honeywell Regulator Co. (National Division), 2701 Fourth Ave., S., Minneapolis, Minn.

Gas Line Cocks Have Recessed Ends

No. 1317—To supplement regular line of iron gas line cocks, a new cock with recessed ends for use on curb box installations has been developed. This new feature is important when it is considered that these cocks are usually buried in the ground below the frost line, where dirt and grit and moisture make their way around the exposed threads of connecting pipes, thus causing corrosion. The recesses are filled with a lubricant or paint.

These cocks are made with flat head, brass plug and washer. Body is of galvanized iron, in sizes ¾, 1, and 1¼ in. They are air tested to assure tightness, and are recommended for non-shock working pressure of 125 lb cold water, oil, air or gas.—Crane Co., 836 S. Michigan Ave., Chicago, Ill.

Rotary Pump Unit Is Portable

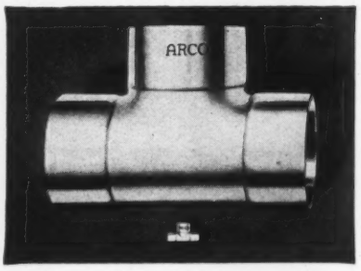
No. 1318 — New portable rotary pump is offered in two sizes, with capacities of 10 and 20 gpm. It incorporates a "Bucket" design which results in automatic take-up for wear.

The illustration shows a V-belt drive from motor to pump which is completely enclosed by a removable guard. Silent chain drive can be furnished in place of V-belt if desired. The castors furnished are free swinging type, making the outfit an easy one to move from one pumping job to another; or the unit can be furnished without castors where a permanent installation is required. The pump can be driven from the lighting circuit, tapping in at the nearest electric outlet.

This unit can be used for pumping practically any liquid of any viscosity, says the maker. It is positive in displacement, designed for high suction lifts, and needs no priming.—Blackmer Pump Co., 1809 Century Ave., S. W., Grand Rapids, Mich.

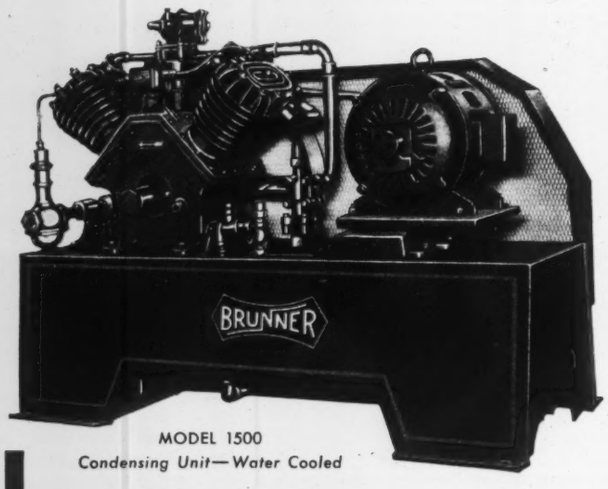
Wrought Copper 4 In. Tee Announced

No. 1319—Development of a new 4 in. copper tee for copper to copper to copper sweat connections has been announced. The tee, said to be the largest wrought copper tee ever developed, together with the 4 in. elbow and other fittings in this size recently placed on the market, completes the size range in copper fittings from ¼ to 4 in.



At the same time the manufacturer also announced the development of a wrought copper expansion joint for use in all cases where allowances for line expansion must be provided. The new expansion joint is made for copper to copper sweat connections from ¾ to 2 in. sizes and is the only wrought copper fitting of its kind ever developed, according to the announcement.—American Radiator Co., Arco Pipe and Fittings Division, 40 W. 40th St., New York, N. Y.

NEXT YEAR *at this time*

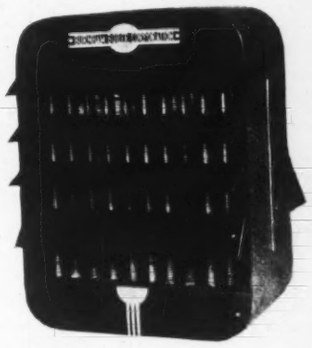


MODEL 1500
Condensing Unit—Water Cooled

Air conditioning paces ahead with unprecedented speed . . . New designs . . . New hook-up . . . New fields to conquer. But pause! Be sure the system you install today will still be delivering honest, day-in, day-out service next year at this time, *and years after that!*

Brunner Condensing Units are engineered "with an eye to the future"—yet constructed with that rugged dependability gained through a quarter century of experience. Here, truly is effective refrigeration at minimum cost. The Brunner line includes fifty-eight condensing units—air and water cooled—for installations from 100 lbs. to 15 tons of refrigeration. Write: Brunner Manufacturing Company, Utica, N.Y., U. S. A.

Brunner CONDENSING UNITS



Each Unit is guaranteed for any steam pressure up to 150 lbs.

Hank

tells some truths about this Hot Air Shooter

(Others Call It A Unit Heater)

Some time back I got alfired hot under the collar trying to cool off. Then again, I got cold feet because I wuz hot-headed. But I ain't both or neither, right now.

You see twuz this way. Along last year about now time, I wuz all het up about our Unit Heater. Told the Boss it was God-awful looking. Told him there warn't no sense in anything doing the double-plus job that heater did, to look like it wuz mad all the time doing it.

He contended it oughter look what it wuz, and not be something all dolled up like it was trying to look like a box of candy or something that all it needed wuz a bow o' ribbon on it.

However, twarn't long before he called me in and showed this mighty good-looking one, and got off a lot of talk about its being restyled. He said as how its innards were just the same efficient hot-air-shooters as ever.

Now if you really want the down low on this Unit Heater, there's allus the catalog. That's mostly the idea of having it, thinking maybe you might be a sending for it.

Hank Hindle

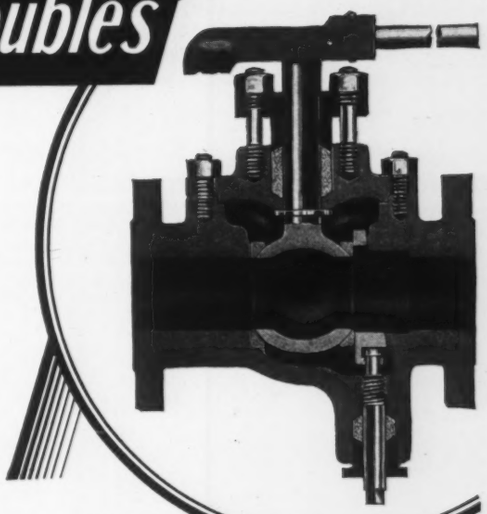
Burnham Boiler Corporation

Manufacturers of Heating Equipment Since 1873

Irvington, New York Zanesville, Ohio

Burnham Boiler

No More Blow-Off Troubles



SPHERO Ball Valves are designed for general blow-off purposes or other services where a full flow, quick opening valve is desired.

Fairbanks Sphero Valves are *different.* Instead of a wedge or disc, there is a *revolving ball plug.* When open this plug gives an opening the same size as that in the pipe. That eliminates frictional resistance to stream flow.

There is nothing on which scale and foreign matter can accumulate. The shearing action of closing the plug cuts through any foreign matter or thick viscous materials. An absolutely tight seal is assured.

Seating surfaces can be renewed without removing valve from the pipe line.

Another difference in Sphero is that a quarter turn of the lever handle opens or closes it in one second.

We are so certain that this valve will give satisfaction that we will send one on trial with the understanding that it may be returned in 30 days if not entirely satisfactory.

Send for one on trial today. Also ask for Catalog No. 21.

THE FAIRBANKS COMPANY

Valves, Dart Unions, Hand Trucks and Wheelbarrows

396 Lafayette St. New York, N. Y.

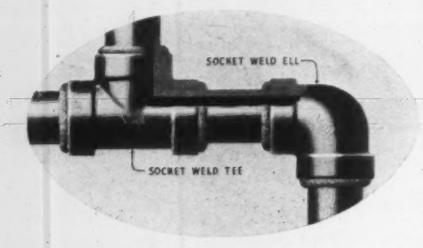
Boston, Pittsburgh—Distributors in Principal Cities

Factories: Binghamton, N. Y.; Rome, Ga.

Fairbanks Sphero Valves

Steel Weld Fittings Have Socket Ends

No. 1320—New drop forged steel weld fittings are provided with socket ends to receive the pipe, thereby making proper alignment certain before and after welding; no weld "icicles" can clog the pipe or fitting because of the socket construction, says the



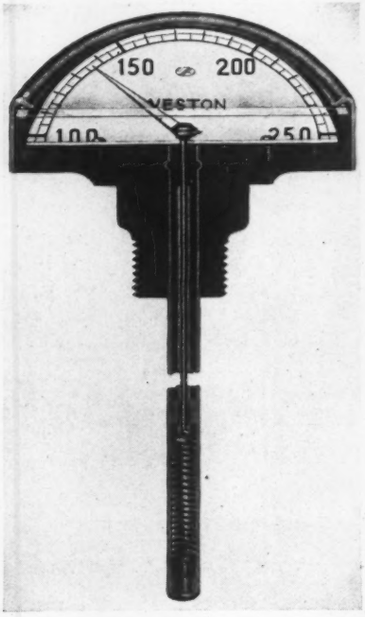
manufacturer. Whether standard, extra strong or double extra strong pipe is used, a smooth passage is assured through pipe and fittings since the fitting bores match the inside diameter of the pipe.

The fittings are available from stock in sizes from ¼ to 6 in. —Henry Vogt Machine Co., 10th and Ormsby Sts., Louisville, Ky.

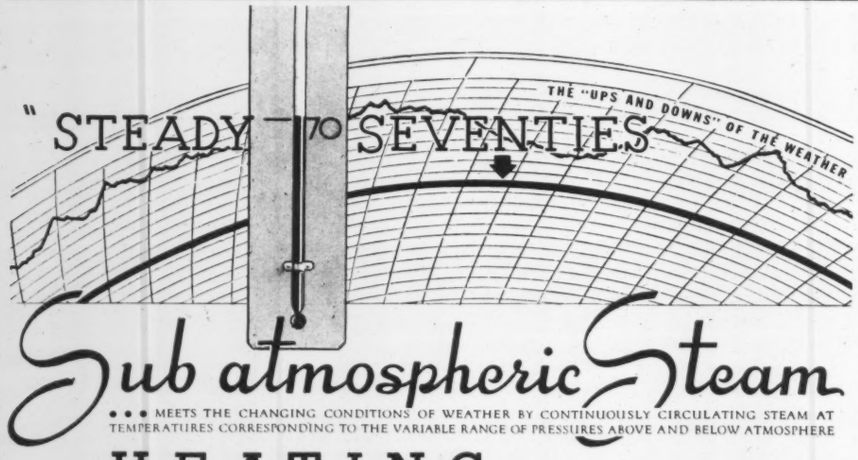
Temperature Gauges for Industrial Use

No. 1321**—The initial units in a line of modern temperature gauges have just been introduced. They are of the dial and pointer type, said to be the first industrial application of a new "coils-within-coils" design for the bimetal temperature sensitive element. This all-metal temperature element is sheathed within a stainless steel stem. The circular dial case, 3 in. in diameter, is mounted at right angles to and at the top of the stem. Accuracy is guaranteed to 1 per cent over the entire scale, says the maker.

Three models are being introduced for use in checking operating temperatures in industrial applications such as heaters, dryers, baking ovens, and small furnaces which have operating temperatures below 1000 F: (1) For dryers, having a range of 50 to 500



F; (2) For bakery ovens, having a range of 150 to 750 F; (3) For industrial ovens, having a range of 200 to 1000 F.—Weston Electrical Instrument Corp., 619 Frelinghuysen Ave., Newark, N. J.



Sub atmospheric Steam

• • • MEETS THE CHANGING CONDITIONS OF WEATHER BY CONTINUOUSLY CIRCULATING STEAM AT TEMPERATURES CORRESPONDING TO THE VARIABLE RANGE OF PRESSURES ABOVE AND BELOW ATMOSPHERE

HEATING

The experience of any winter demonstrates the sound superiority of DUNHAM SUB-ATMOSPHERIC STEAM HEATING, for although "base temperatures" are occasionally reached during cold "snaps," 95% of average winter weather is thirty to forty degrees above that point . . too mild for the heat output of pressure steam . . . too cold for no heat. This condition is ideally met through DUNHAM DIFFERENTIAL HEATING with its utilization of the variable temperatures of Sub-atmospheric steam.

The maintenance of "Steady-Seventies" room temperature during mild "spells" as well as cold "snaps" is but one important value of Dunham Sub-atmospheric Steam Heating. Another, important to the financial success of the building, is the fact that a hitherto unattainable degree of economy becomes a daily commonplace in all weathers.

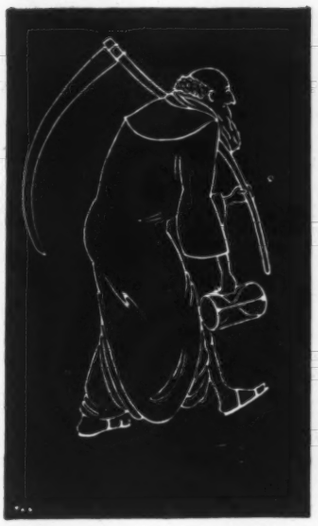
Steady-Seventies for the larger project under full-automatic control —may be approximated for the moderate size building under manual control. Steady-Seventies for buildings already operating—may be secured without replacing steam source, piping or radiation.

"Cool Steam," an interesting brochure on Sub-atmospheric steam, is the first step towards "Steady-Seventies." May we send it?

Consult the Architect for good design and the Consulting Engineer for mechanical equipment.

C. A. DUNHAM COMPANY

450 EAST OHIO STREET, CHICAGO



FATHER TIME CUTS NO FIGURE

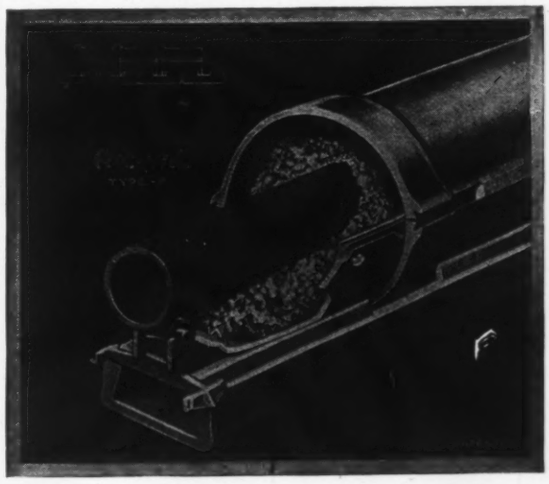
TIME with his scythe cuts no figure on a Ric-wiL Underground Conduit System. Especially, he doesn't cut the efficiency figure—that good old 90%+! Steam lines encased in Ric-wiL are just about *proof* against the onslaughts of Time—they go right on defying deterioration from moisture, corrosion, inside or outside pressure. That's *permanent* protection!

Water repellence, heat retention, underdrainage, alignment, ease of assembly—all these vital requirements are completely met. Various designs in Tile or Cast Iron to meet all conditions—famous Dry-paC Waterproof Asbestos Insulation. Submit your underground steam problems to Ric-wiL. Ask for complete catalog with Dry-paC sample for testing.

The Ric-wiL Co., Union Trust Bldg., Cleveland, Ohio
New York San Francisco Chicago

Agents in Principal Cities

Standard Ric-wiL Conduit is assembled on the job—all materials and workmanship are absolutely *open* to inspection.

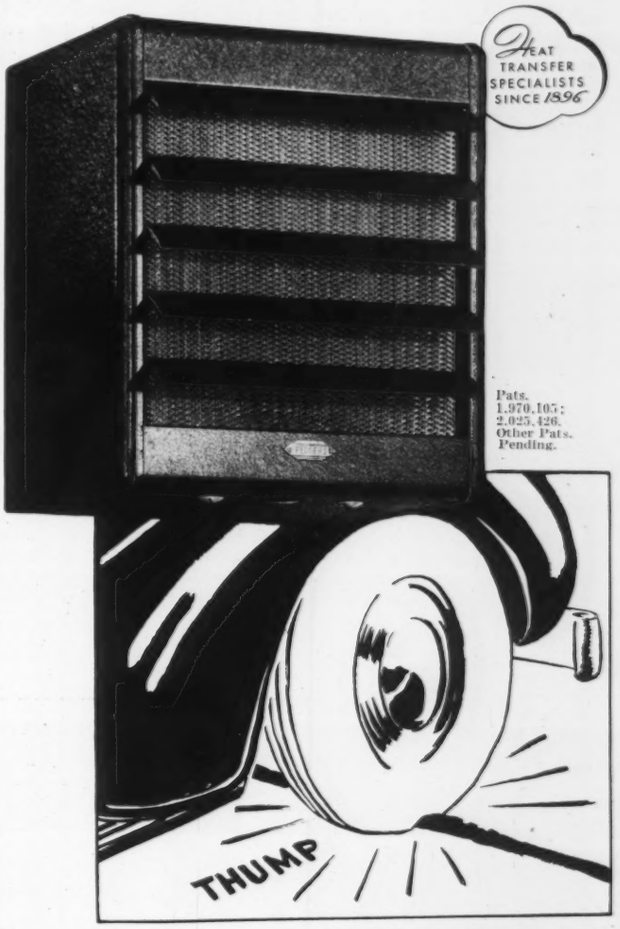


REGISTERED IN U. S. PATENT OFFICE

·RIC-WIL·

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

PAVED ROADS *Are Protected Against* EXPANSION



and so are FEDDERS UNIT HEATERS

The "thump, thump," you get when driving over concrete roads is a reminder that expansion joints have to be provided to protect the life of the pavement. Fedders Unit Heaters exclusive full-floating telescoping mountings permit free movement of the heating element vertically in cabinet, and also protect it from torsional stresses. Tubes having 3 to 1 streamline ratio and individual convoluted fins allow each tube to "give" laterally, thus relieving differential expansion stresses within the element. This also allows the use of curved, non-diaphragmatic headers, assuring a stable heating element. Fedders convoluted fins are saddled over sides of tubes, to eliminate heat expansion stresses between fin and tube, thus maintaining a permanent thermal bond. Accordion design of fins eliminates stresses between bonding points.

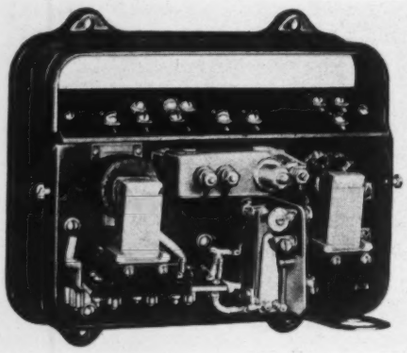
Quieter operation and handsome, sturdy mono-piece cabinets make Fedders Unit Heaters ideal for economical as well as industrial applications. Write for Bulletin 572.

FEDDERS MANUFACTURING CO.
BUFFALO, N. Y.

Air Conditioning Units—Blast Heating and Cooling Surfaces

Controls Industrial Oil Burners

No. 1322—An industrial oil burner control system that will give a timed sequence of the burner's operation known as the "Protectorelay" permits predetermined ignition timing, delayed opening of the oil valve, if required, and timed scavenger or recycling period, according to the maker. It incorporates the basic "Series 10" circuit using one line voltage and one low voltage relay. One time switch is utilized for both ignition and oil valve as well as providing a timed delayed return to the cold position. The "Protectorelay" is offered for use with the "Pyrostat," mounted in the stack or breeching, to provide safe operation of the burner.



This three wire safety control overlaps on the heating cycle but not on the cooling cycle. The ignition switch timing is adjustable from 45 to 120 seconds with a factory setting of 120 seconds. The delayed oil valve timing is approximately 25 to 35 seconds, and the safety switch timing is approximately 80 to 100 seconds. Current rating is 10 amp at 110 volts and 5 amp at 220 volts with a motor rating of 1 hp repulsion induction and ½ hp split phase.

Finished in black and approximately 7½ in. high and 7⅞ in. wide.—Minneapolis-Honeywell Regulator Co., 2701 Fourth Ave., S., Minneapolis, Minn.

High Pressure Valves of New Design

No. 1323—A new type of steel valve, called the "Hancock Duravalve," has been developed expressly for high pressure and high temperature service (1500 lb at 950 F).

The makers claim that with internal "Stellite" seats they end valve maintenance due to steam leaking between the valve seat ring and the valve body. The illustration shows how the design permits the "Stellite" seat facing to be welded in and serviced even on small size valves.

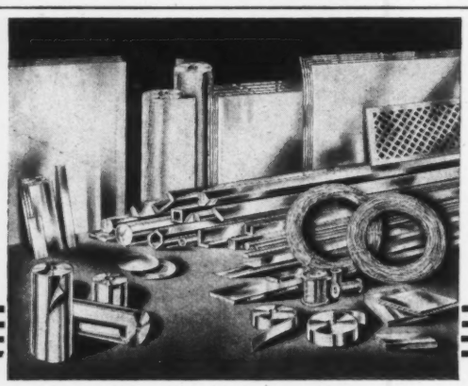
These valves are made in one basic size and then tapped, or bored for welding, for ½, ¾ or 1 in. pipe. The builders state that this simplification will take care of 90 per cent of the small valve requirements on any high pressure power plant job, and that it cuts repair part stocks and maintenance parts by two-thirds.—Hancock Valve Div., Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

Thermometers Are Modernized

No. 1324—A modernized line of indicating and recording thermometers, incorporating improvements in design, construction and operating characteristics, are known as "Mono-therm" thermometers. They employ an improved thermal system which provides a complete permanent seal for the actuating medium, the maker states.

Available with the recording thermometers is a new extra

HUSSEY COPPER



A QUALITY SPECIFICATION FOR 89 YEARS

When time must be saved . . . when you need copper *quick*, just reach for your telephone and call HUSSEY—general headquarters of the refrigeration and air conditioning industry for quality copper and brass products.

HUSSEY Copper Service is backed by the accumulated experience of 89 years of progressive specialization in copper manufacture from mining and refining to rolling and fabrication—a service that is 100 per cent COMPLETE.

Write for the Hussey Catalog—you will find it a valuable source of information and a real time saver.

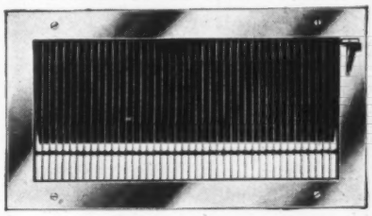
C. G. HUSSEY & COMPANY
A Division of Copper Range Co.
Rolling Mills and General Offices: PITTSBURGH, PA.
Warehouses in Principal Cities

Copper HUSSEY Brass

PROMPT SHIPMENTS FROM STOCK

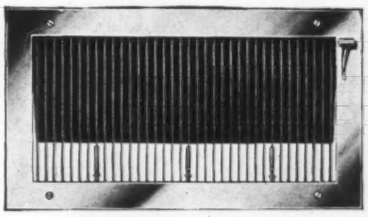
Tuttle & Bailey have built up a large stock of all sizes most in demand of the four most popular face designs of Air Conditioning grilles, registers and intakes. Immediate shipment can now be made from the factory. Avail yourself of this special service, so unusual in the air conditioning field.

AIRLINE REGISTER, GRILLE, INTAKE



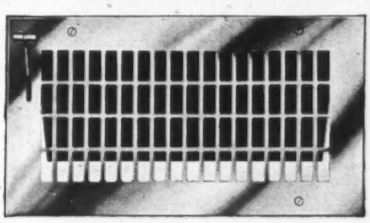
The leading Air Conditioning face design for fixed air deflection. All popular sizes in stock.

FLEXAIR REGISTER, GRILLE, INTAKE



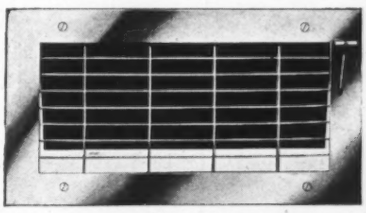
Air deflection adjustable at the outlet. All popular sizes in stock.

ECONOMAIR REGISTER, GRILLE, INTAKE



Ideal face design where costs must be kept down. In stock in all popular sizes.

FERROGRID REGISTER, GRILLE, INTAKE

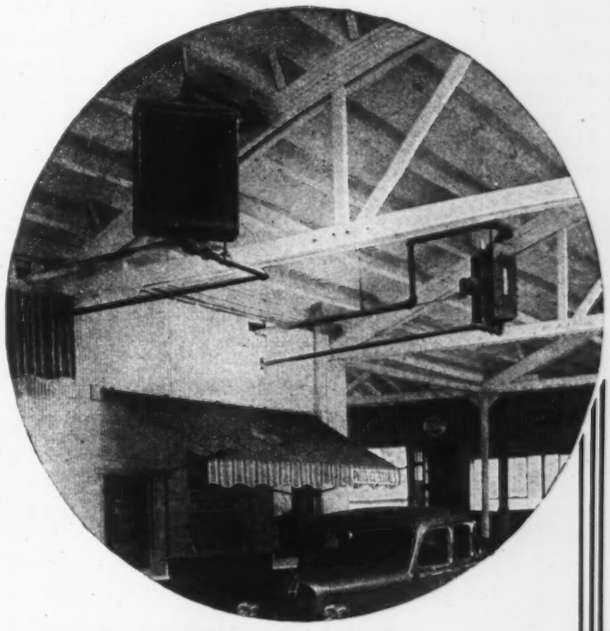


Inexpensive and attractive laced bar design. In stock in all popular sizes.

"THE STANDARD OF COMPARISON"

T & B

TUTTLE & BAILEY INC.
NEW BRITAIN, CONN.



REDUCE HEATING COSTS

WITH

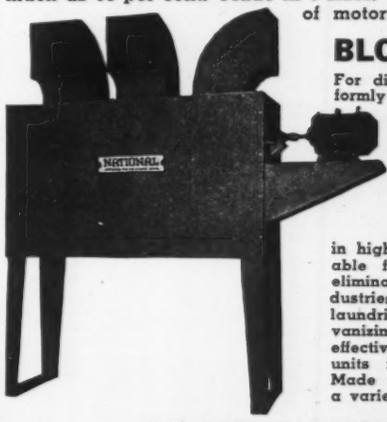
NATIONAL
FAN AND BLOWER CORP. CHICAGO, ILL.

UNIT HEATERS

A carefully engineered, highly efficient heater that will give years of dependable service at an exceedingly low operating cost. There is a full range of sizes in each of three types that will cover all requirements.

SUSPENDED TYPE

Designed for overhead installation. They furnish the necessary volume of heat where wanted, raise the temperature a degree a minute and cut costs of heating as much as 30 per cent. Made in 8 sizes, with wide variety of motor speeds.



BLOWER TYPE

For distributing heat uniformly over large areas. Air is heated by passing over the coils and is discharged, in liberal volume, over the heads of the workers in the room. Especially effective in high buildings. Adaptable for fog and steam elimination in such industries as packing plants, laundries, dairies and galvanizing plants. Also effective as ventilating units in warm weather. Made in four sizes, with a variety of motor speeds.

100% AGENCY FRANCHISE

We have an exclusive agency franchise on the complete National line of air conditioning equipment, including blowers, propeller fans, air washers, etc. State territory desired.

NATIONAL FAN AND BLOWER CORP.
540 W. Washington Boulevard, Chicago, Ill.

The *AIRBLANKET* Definitely Reduces Heating Cost

. . . because only the AIRBLANKET brings below breathing level comfort with above breathing level economy.

This amazing unit heater does not rely upon fins, louvers, deflectors or other ordinary devices to retain the heat in the working zone. An entirely different principle, using a high velocity of cool air to roll the stream of warm air down against the floor provides absolute control of the warm air.

Ten Years Success

During the past ten years many of America's "Hardest-to-Heat" buildings have been comfortably and economically warmed by this simple, proven method of heat distribution . . . the Exclusive *AIRBLANKET* Method.

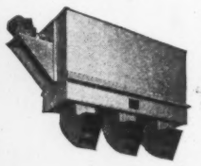
Don't buy any unit heater until you have secured full details on the *AIRBLANKET*.

Correctly Engineered Unit Heaters by Airtherm

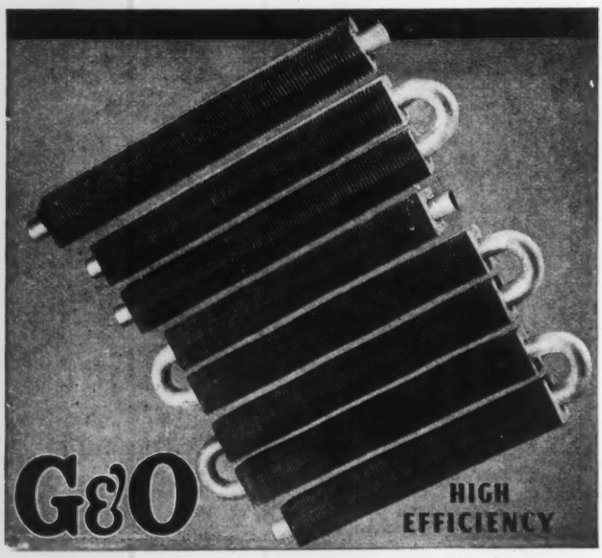
Capitalizing thirty years research and experimentation Airtherm Engineers have produced the ultimate in unit heater efficiency and design. In addition to the *AIRBLANKET*, the Airtherm Line includes the Airvector (Fan Driven Units) and the Airheator (Blower Driven Units)...both of which embody many new, exclusive features in unit heater construction and performance.

Write for full details of the Airtherm line including the *AIRBLANKET*, at once.

The AIRBLANKET is available for ceiling or floor mounting.



AIRTHERM MFG. CO.
1478 So. Vandevanter Ave., St. Louis, Mo.



SQUARE FINNED TUBING

WE are splendidly equipped to supply high efficiency Finned Tubing and Complete Coils for all heat transfer purposes.

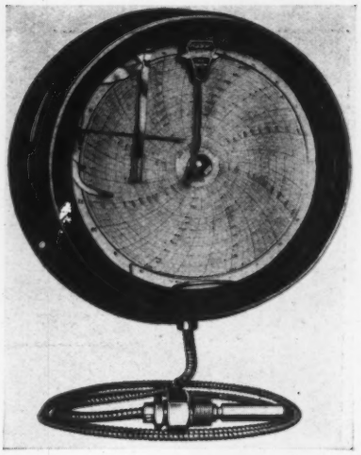
Special Shapes, Bends and Continuous Coils

Correspondence invited.

The G&O Manufacturing Co., New Haven, Conn.

Pioneer Manufacturers of Individual Square Fin Tubing in the United States

over-range protection. The liquid filled instrument can be protected against an over-range up to a maximum of 500 F. Similarly, the gas filled instrument can be protected against an over-range of 100 per cent up to a maximum of 1000 F. The vapor pressure type can be protected for a 100 per cent over-range to the breakdown point of the actuating medium.

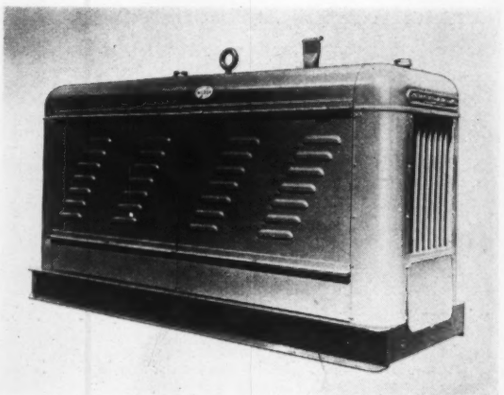


A wider bourdon spring and a larger, stronger movement give the vapor pressure indicating thermometer greater durability and ruggedness. The gas filled recording thermometer also employs a new wide spring which adds to its power.—Foxboro Co., 106 Neponset Ave., Foxboro, Mass.

Welder for Pipe Line Work

No. 1325—New "Yellow Jacket" electric welding machine has been designed exclusively for pipe line work. It is obtainable in 300 and 400 amperage capacities.

Of rugged construction, its features include double sediment collectors for carburetor supply, improved foolproof idling device, 36 gal capacity gasoline tank, and improved current switch. Other features are close coupled design, lowered center of gravity of 1 ft, light weight reinforced base and framework, center lifting bail, and double-radiator protecting grill.—Wilson Welder and Metals Co., Inc., 60 E. 42nd St., New York, N. Y.



Hanger for Blueprints

No. 1326—Print binder hanger to hold up to 75 blueprints, maps, etc., is made of light duralumin with center hook of steel that can be turned back for reference. Three telescoping binder screws with a metal strip at back hold the prints firmly to eliminate loosening, falling out and tearing. Three holes for permanent or slots for temporary insertion are easily cut in the prints with a knife or shears.

There are no projecting screws or sharp edges to cut and mar prints. A renewable title strip is provided and may be lettered to suit. It slides in a T-slot at top of the hanger and is sloped at a visible angle. A strip of celluloid protects the title card.

Stock sizes are 18, 24, and 30 in.; any size 12 to 48 in. may be made to order.—Wade Instrument Co., 2246 Brooklyn Sta., Cleveland, Ohio.

CUTS OFF Practically WITHOUT BURR

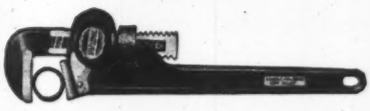
And This RIDGID Thin Tool Steel Blade Wheel Is The Reason

If you want a new experience that will show you how quickly, easily and cleanly pipe can be cut, try a RIDGID Cutter.

You'll find the patented RIDGID Cutter wheel a real improvement. Coined out of tool steel sheet, hammered, heat-treated and cast into a steel-bearing hub, it rolls smartly through any pipe, practically without burr—many more cuts per wheel.

Try one at your Jobber's

Save 75% of Your Pipe Wrench Repairs



The RIDGID Wrench housing is unconditionally guaranteed not to break or warp—so goodbye to 75% of your wrench repairs.

THE RIDGE TOOL CO., ELYRIA, OHIO

RIDGID PIPE TOOLS

PIPE WRENCHES, CUTTERS, THREADERS, VISES, EXTRACTORS

FOR INSULATING DUCTS

Efficiently—

Quickly . . . and Economically

SPECIFY

CELOTEX

Reg. U. S. Pat. Off.

FOR solving air conditioning duct insulating problems—quickly and effectively—engineers everywhere are specifying Celotex.

Celotex is the big, lightweight, rigid, cane fibre insulating board that handles easily, goes up fast—stays put. And it permits the maintenance of desired temperatures economically, because it *fits tight* and has a thermal conductivity of only 0.33 Btu. per inch thickness.

For insulating cold air ducts, specify Celotex VLTI—the low temperature insulating blocks that are *doubly sealed* against vapor penetration by a special asphalt coating and a vaporproof membrane wrapper. They *keep out* moisture—*keep down* operating costs. The conductivity of Celotex VLTI is 0.30 Btu. per inch thickness.

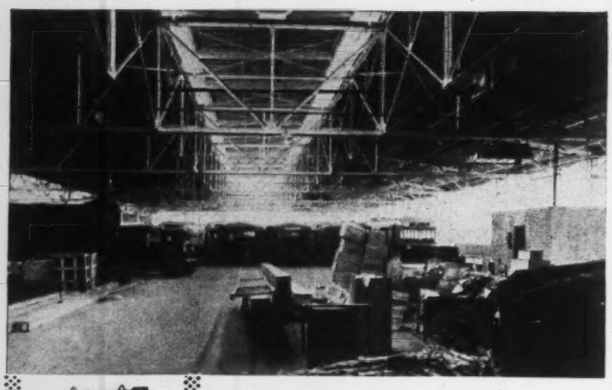
Both Celotex Insulating Cane Fibre Board and Celotex VLTI are protected against termites and dry rot by the *exclusive* Ferox Process (patented). For all the facts about these widely used insulations—write us today.

THE CELOTEX CORPORATION • 919 N. MICHIGAN AVE., CHICAGO, ILL.

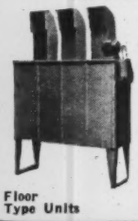
CELOTEX

BRAND—INSULATING CANE BOARD
Reg. U. S. Pat. Off.

Sales Distributors Throughout the World



Suspension Units



Floor Type Units

YOUNG UNIT HEATERS offer the ideal type of heat for factories, warehouses, etc., as well as lower heating costs. From the complete catalog line of Young units you can select a unit to meet your exacting requirements.

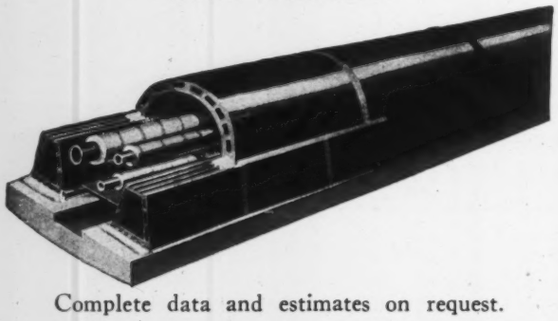
Suspension type units are available in 24 Models with capacities from 18,000 B.t.u. to 658,000 B.t.u. per hour. There are ten floor Models varying from 120,000 to 800,000 B.t.u. capacities.

YOUNG RADIATOR COMPANY
RACINE, WISCONSIN
Young Quality

THERM-O-TILE

The Conduit for Underground Steam Lines

Simplest
Strongest
Most Efficient



Complete data and estimates on request.

Sold and Installed by Johns-Manville Construction Units in all Principal Cities.

H. W. PORTER & CO., INC.
825 FRELINGHUYSEN AVE., NEWARK, N. J.

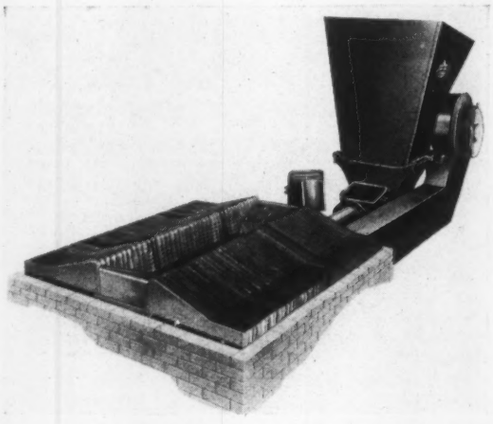
Smoke Pots for Testing Air Movements

No. 1327—Smoke pots are offered in five sizes for use in testing air movements in air conditioning work, locating leaks, and for laboratory work. The capacities available are ½, 1, 2, 3 and 5 minutes.

According to the manufacturer, use of these pots eliminates a fire hazard and represents an economical method. The smoke is generated immediately and the effectiveness has been proved by wide use in varied fields.—Pains Fireworks Display Co., Inc., 22 Park Pl., New York, N. Y.

Burning Head for Coal Stokers

No. 1328—The "Power-Flex" burning head, which has been tested in the laboratory and in actual use, was announced recently as standard equipment for the manufacturer's commercial and industrial stokers. Originally designed for the burning of eastern, hot, low ash coals—which, according to the maker, are

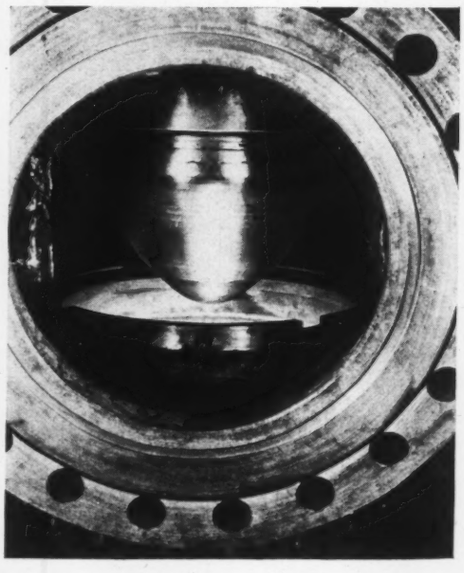


detrimental to conventional tuyere block and dead plate stokers—the success of the "Power-Flex" was so gratifying that experiments were started in its use with high ash coals. The feature of the method is that it does not use dead plates.

Advantages are stated to be that the greater active coal burning area increases boiler capacity and efficiency and that it is most flexible in adaptability to local combustion conditions.—Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.

Controls Flow of 350,000 Lb of Steam Per Hr

No. 1329—Illustrated is the "Stellite" seat and disk (after machining) installed in the body of a flow control valve recently

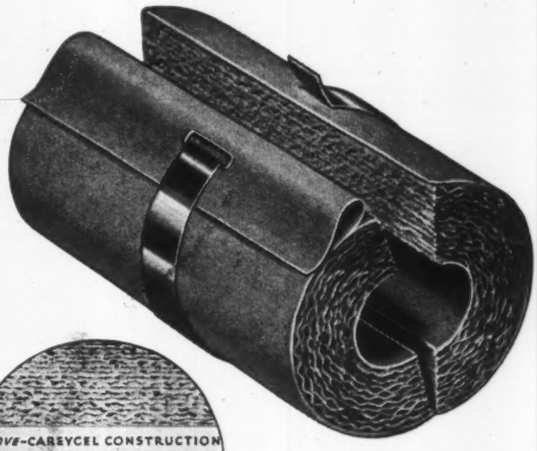


• Satisfy Customers
• Build Business
• Increase Profits

with

Careycel

THE MODERN PIPE COVERING FOR LOW PRESSURE STEAM AND HOT WATER SYSTEMS



Note the smallness of air spaces in Careycel as compared with ordinary air cell covering. The unique construction of Careycel is the main reason for its high efficiency—and is made possible by the exclusive process of "Cellizing" the asbestos sheets during process of manufacture.

The rate of heat loss through CAREYCEL is 30% less than through an equal thickness of the air-cell type of insulation. CAREYCEL shrinkage is only 1/10th that of air-cell . . . unsightly, heat-wasting cracks at joints are eliminated . . . a better looking job is assured.

Notwithstanding these exclusive advantages — conclusively proved by impartial tests at Mellon Institute—CAREYCEL sells in same price range as air-cell. Samples and convincing facts mailed upon request. See nearest Carey Distributor or write Dept. 25.

THE PHILIP CAREY COMPANY

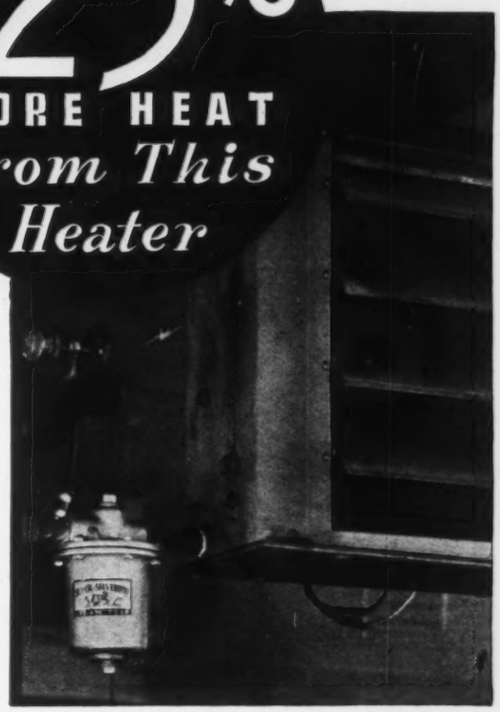
Dependable Products Since 1873

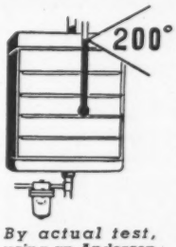
Lockland • Cincinnati, Ohio

BRANCHES IN PRINCIPAL CITIES

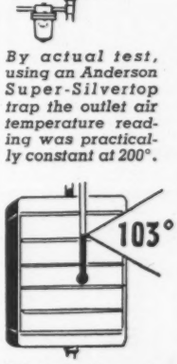
Careycel ASBESTOS **INSULATION**

25% MORE HEAT *From This Heater*





By actual test, using an Anderson Super-Silvertop trap the outlet air temperature reading was practically constant at 200°.



When using an inefficient steam trap the temperature reading varied from 103° to 144°.

BEFORE the above unit heater was drained by an Anderson Super-Silvertop steam trap, the heater's output was less than its rated capacity. After an Anderson Super-Silvertop was installed, the heater output was increased 25%. The Super-Silvertop steam trap kept the unit heater free of condensate at all times and permitted the heater to develop maximum heat output.

The sketches at the left show the direct effect of condensate on unit heater performance. When the heater is free of condensate, a higher temperature is obtained than when heater is partly filled with water. The reason, of course, is that the amount of heat available from condensate is negligible compared to the heat available from steam. Hence to get maximum output it is necessary to keep the heater free of condensate.

Don't blame your unit heater for poor performance—check up on the steam trap—be sure that the unit heater is well drained. Replace inefficient steam traps with Anderson Super-Silvertops and specify Super-Silvertops on your next installation. Send us the name of the unit heater you are interested in and we will send data sheets showing the proper size steam trap for each size of heater—write today.

The

V. D. ANDERSON CO.

1949 WEST 96TH STREET · CLEVELAND, OHIO

HYDRON METALLIC BELLOWS
are used as
CONTROL ELEMENTS

in temperature and pressure control devices and for liquid or gas seals of compressors and pumps. The hydraulic method of manufacture from which the Hydron Metallic Bellows derives its name results in a superior product which is repeatedly establishing unusual records of performance and service.

"Write for our new catalog describing and explaining the advantages of the Hydron and containing complete engineering data from which to design all types of pressure and temperature controls."

CLIFFORD MFG. CO.
564 East First Street Boston, Mass.

MONARCH
RE-COOLING NOZZLES

Monarch Fig. B-8 and B-8-A cast Brass nozzles, for cooling condensing water in spray ponds, use no internal vanes or deflectors which might facilitate clogging. Available in capacities up to 104 G.P.M. at 10 lbs.

For industrial air washers we recommend our ¼" Fig. 631 (female) or ¼" or ⅜" Fig 629 (male pipe) delivering from 4.7 G.P.H. up at 20 lbs. pressure.

For air conditioning our brass Fig. F-27 (⅛" or ¼" female pipe) or Fig. H-261 (¼" male pipe) nozzles produce a very fine spray using city water pressure.

Write for Catalog 6-A

Fig. B-8

MONARCH MFG. WORKS, INC.
2728 E. Westmoreland St., Philadelphia, Pa.

manufactured and designed to control the flow of steam over a range of from 100,000 to 350,000 lb of steam per hr. Size is 16 in. and the pressure rating is 400 lb.

Contour of the disk provides for equal increments of flow for equal amounts of handwheel or motor control operation. Relays and switches enable operation from remote points.—Edward Valve & Mfg. Co., Inc., 1200 W. 145th St., East Chicago, Ind.

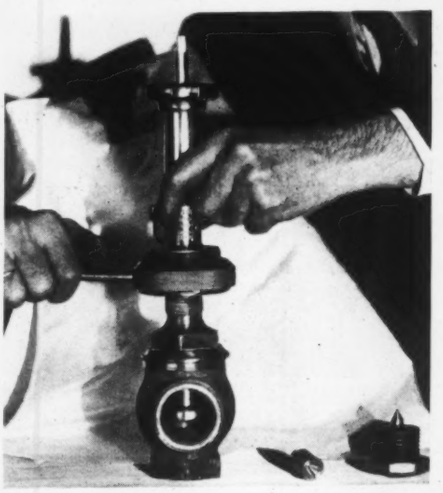
Flooded Roofs Reduce Heat Gain

No. 1330—Specifications for water cooled roofs for reducing the heat gain of air conditioned buildings have recently been issued. These roofs are constructed of coal tar roofing pitch and tar saturated rag felts. A double poured top of pitch and slag or gravel is applied over the solidly mopped felts. When applied in accordance with the manufacturer's specifications, these flooded roofs can be bonded for 10, 15 or 20 years.

Specifications are available for spray pond or water cooled roofs over wood deck or precast gypsum slab, or over poured concrete, poured gypsum, precast concrete slab, or book tile.—Koppers Co., Tar and Chemical Division, Pittsburgh, Pa.

Reseater for Valves and Faucets Offered

No. 1331—Illustrated is a tool for renewing the efficiency of corroded or worn out valves and faucets by reseating them without removing them from the line. Operation is simple and calls for no special training, according to the manufacturer.



The equipment will insert removable seats in vacuum traps, small steam valves, faucets, etc., ranging in size from ¼ to $\frac{9}{16}$ in.; the same company makes equipment to insert removable seats up to 1½ in. and resurfacing tools to renovate valves up to 5 in.—Standard Reseater Corp., 423 W. 126th St., New York, N. Y.

The coupon on page 144 is designed for your convenience in obtaining more information about any of these Equipment Developments.

Welding fittings at their best

WELD your pipe lines—for added safety and added strength with lighter weight—for smooth-flow interiors—for smooth, sightly, easily insulated exteriors. Taylor WeldELLS head the list of Taylor Forge *Engineered* Welding Fittings. They are reinforced at the crotch where strain is greatest—have tangents which remove the weld from the curved section—have machine tool bevelled welding surfaces which permit sound, dense welds.

The Taylor Forge line covers every need. It is the most complete line made.

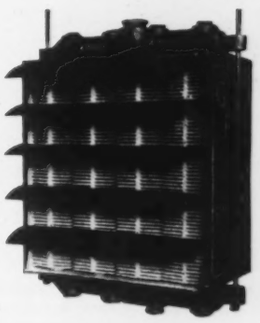
TAYLOR FORGE & PIPE WORKS
General Offices and Works:
P. O. Box 485, Chicago,
New York Office: 50 Church St.
Pittsburgh Office: Gulf Bldg.

Also made from BYERS GENUINE WROUGHT IRON PIPE

TAYLOR FORGE
WeldELLS
SEAMLESS PIPE FITTINGS FOR WELDING

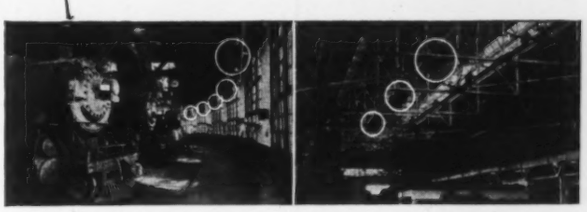
Again We Repeat
NO OTHER UNIT HEATER LIKE THE

GRID



In it there are no soldered, brazed, or expanded joints or unions. The Grid Patented "fin" or heating sections are made of special aluminum alloy cast metal to metal bonded to cast high test iron steam chambers—the sturdiest heating elements possible to put into a unit heater. No electrolytic action can ever develop to cause corrosion with resultant leaks. The Grid is built like a piece of machinery—to last indefinitely. We'll gladly send you complete data.

THE UNIT HEATER & COOLER CO.
Wausau, Wis.
Offices in all principal cities.



KNOW AIR CONDITIONING

Learn every phase of this important subject by sending today for a copy of

LEWIS' NEW "Air Conditioning for Comfort"
by SAMUEL R. LEWIS

277 *Pages*—$2.50
Large Psychrometric Chart

So understandably does this new volume cover all angles of air conditioning that already dozens of schools teaching air conditioning have adopted it as a text. From it anyone may quickly acquire a thorough knowledge of equipment, psychrometry, refrigeration, humidification, dehumidification, heat transmission, heat absorption, air distribution, and water circulation. It also explains every step in the design of a complete heating and cooling system for a typical residence and a typical commercial building.

Send $2.50 for a copy today. You may return the book and your money will be refunded promptly if it does not prove satisfactory in every way.

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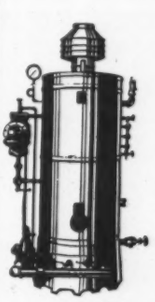
If "Old Faithful" ever fails we wish you'd wire us, right away. We can fix it. We're makers of the KANE Automatic Gas Fired Steam Boiler—and that's first cousin to "Old Faithful" in the automatic precision and regularity of its performance.

It won't cost you much to run, either; it burns gas only in proportion to the required steam—and does that automatically, so there's no labor except for the few minutes required to regulate it each day.



And—in case you need it—we can rush it right to you and hook it up before the tourist trade knows the difference.

P. S. Ask any industrial user, if you want a 1st class recommendation. Details and prices, if you'll write.

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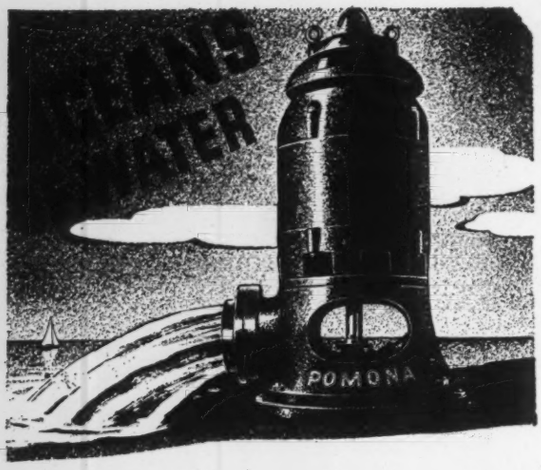

Drill a well that flows eight thousand gallons a minute and Pomona can set a pump to deliver the water. Thousands of Pomona Pumps of this and smaller sizes are delivering water in forty-eight states and thirty-four foreign countries. Look into the pumping equipment of well managed municipalities, industries, mines, farms and private enterprises and you will usually find Pomonas—often in multiples—two, six, eleven, and even as many as twenty-one. These repeat orders tell the story of Pomona dependability and economy.

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Quiet
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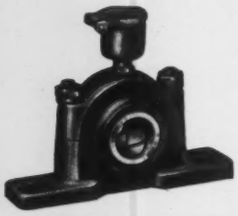
PILLOW BLOCKS
long-lived, and economical, too!

When Randall pillow blocks are built into your units your bearing worries end. Proof of that has been established by their use as standard equipment on more than 75% of the air conditioning units manufactured. Randall pillow blocks are self-aligning, self-lubricating and quiet. They operate with a minimum running torque and will last indefinitely with a minimum of attention. Upon request complete information will be sent without obligation.



Randall Standard Pillow Block assembled.

Cut-away section of ball of Randall Standard Pillow Block.

Randall GRAPHITE PRODUCTS CORP.
Dept. 1010 609 W. Lake St., Chicago, Ill.

Recent Trade Literature

For your convenience in obtaining copies of bulletins, see coupon on page 144

No. 2527. AIR CONDITIONERS: American Radiator Co., 40 W. 40th St., New York, N. Y. 4 p. data bulletin on Series "RH" year round air conditioners for smaller commercial and residential buildings, available for heating, humidification and air cleaning during the heating season or with summer cooling and dehumidification added. Construction, installation and capacity data are given.

No. 2528. AIR CONDITIONING: Research Corp., Chrysler Bldg., New York, N. Y. 8 p. bulletin describing this company's air conditioning system which is basically a chemical absorption and simultaneous heat transfer system for dehumidifying, cooling, humidifying, heating and cleaning air. The summer and winter cycles are described and the various items of equipment discussed in detail.

No. 2529. AIR CONDITIONING COILS: Bush Mfg. Co., 100 Wellington St., Hartford, Conn. 8 p. bulletin on air conditioning coils for cooling by direct expansion, water or brine, and for heating with steam or hot water. Construction of the various types is discussed and illustrated and design conditions are listed.

No. 2530. BLOWER WHEELS: Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill. 4 p. bulletin on blower wheels describing construction and features and giving tables of performance data, dimension drawings and net prices.

No. 2531. BOILER COLUMNS AND GAGES: Yarnall-Waring Co., 102 E. Mermaid Lane, Chestnut Hill, Philadelphia, Pa. 16 p. catalog of "Yarway" water columns and gages for pressures up to 1500 lb, giving detailed information on the construction and applications, a parts list, and tables of dimensions and prices. A number of installations are illustrated.

No. 2532. COMPRESSORS: Frick Co., Waynesboro, Pa. 16 p. bulletin on "Freon-12" compressors with information on their features and construction, and giving specifications and space requirements.

No. 2533. CONTROL: Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill. Folder describing the "Radiostat," an electronic temperature control for stoker installations in hotels, apartment and office buildings. Uniformity of temperature is achieved by balancing three different elements—outside temperature, return line temperature, and boiler pressure.

No. 2534. CONTROL VALVES: Bristol Co., Platts Bridge, Waterbury, Conn. Bulletin on "Synchro" diaphragm control valves giving information on constructional features, operating characteristics and the applications of the various types for pneumatic control of temperature, pressure, liquid level, flow and humidity.

No. 2535. COOLING TOWERS: Research Corp., Chrysler Bldg., New York, N. Y. 43 p. loose-leaf bulletin for executives, architects, consulting engineers and operating plant engineers on "Coey" multi-stage cooling towers. Complete and detailed information is given, tables of standard sizes for various services are reproduced, and a variety of technical and test data are presented. Pictures of several installations are shown.

No. 2536. DIRECT FIRED UNIT HEATERS: Dravo Corp., Dravo Bldg., Pittsburgh, Pa. 20 p. catalog on the "Lee" direct fired unit heater for industrial service, discussing its advantages, describing the construction of the various types for oil, natural gas, coke oven gas, and coal firing, as well as a special industrial type, and giving specifications and other helpful information.

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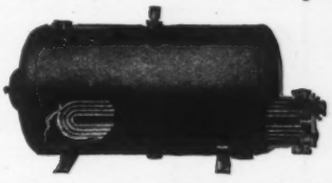
Patterson Everdur or Indestructo *Copper-Lined Heaters* cannot rust. Are practically everlasting. We guarantee these heaters to be rust proof.



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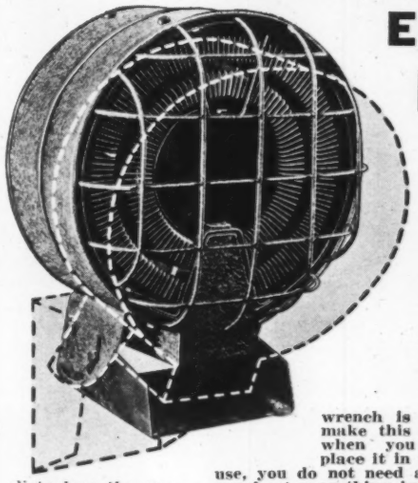

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You can direct the flow of comfort-warmed air from a Chromalox UB unit heater within a wide angle of adjustment. You can put heat exactly where you want it, where it will do the most good. A minute or two with a wrench is all that is needed to make this adjustment. Naturally when you DIRECT this heat, place it in the right spot, plan its use, you do not need as much of it as when you heat everything indiscriminately. Here is an important saving at the outset.

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The Complete Line, 43 models scientifically designed for use in factories, garages, warehouses, stores, shops, theatres, dental and physicians' offices, etc.

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No. 2537. DUCT INSULATION: Armstrong Cork Products Co., 994 Concord St. Lancaster, Pa. Folder announcing a new type of corkboard especially designed for the insulation of air ducts, describing its advantages, among which are insulating efficiency, high resistance to moisture, light weight and flexibility (which makes it easy to shape to sharp curvatures).

No. 2538. GAS BOILERS: L. J. Mueller Furnace Co., 2005 W. Oklahoma Ave., Milwaukee, Wis. 4 p. bulletin describing gas boilers for commercial and industrial buildings, stores, apartments and homes. Sectional construction and other features are explained, dimensional drawings, and dimension and rating tables are given, as are data on capacities for hot water heating.

No. 2539. HARD SURFACING ELECTRODES: Ludlum Steel Co., Watervliet, N. Y. Technical data sheets on new hard surfacing electrodes said to be markedly different in composition from other available welding materials. Information on properties and welding procedure is given, and mimeographed sheets are available presenting general instructions for use.

No. 2540. HEAT: Johns-Manville, 22 E. 40th St., New York, N. Y. 48 p. bulletin, entitled "Heat," telling the dramatic story of man's struggle to control nature's most powerful force. A most interesting discussion of principles illustrated by pictures from this company's motion picture on heat and its control is given, and the second part of the booklet is devoted to insulations and the use of diatomaceous silica, asbestos, and rock wool as insulating materials. Attention is also devoted to the matter of profits from heat conservation by proper insulation.

No. 2541. HOT WATER CIRCULATORS: H. A. Thrush & Co., Peru, Ind. 4 p. bulletin on water circulators for domestic hot water systems describing features and accessory equipment, and showing diagrams of typical installations.

No. 2542. HUMIDIFIERS: Kauffman Air Conditioning Corp., 4485 Olive St., St. Louis, Mo. 4 p. bulletin on portable vaporizing humidifiers for office, factory, or home use which connect to domestic hot water line.

No. 2543. METERS: Roots-Connersville Blower Corp., 16th St. and Columbia Ave., Connersville, Ind. 16 p. bulletin on rotary displacement meters describing general operating principles and listing meters for smaller volumes than heretofore available. The standard low pressure units are for line pressures ranging up to 25 lb and the high pressure type is for maximum pressures of 125 lb. A special construction for pressures of 300 lb or more is illustrated.

No. 2544. MOTORS: Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill. Leaflet describing electric motors, motorized speed reducers, motorized blowers, blower wheels, and other products.

No. 2545. OIL BURNERS: Petroleum Heat & Power Co., 110 Davenport St., Stamford, Conn. 36 p. catalog of "Petro" commercial and industrial oil burners, profusely illustrated. Discussions are given on advantages of oil as a fuel, the principles involved in its use, and this company's rotary cup type burner. Information is also given on automatic operation with heavy fuel oil, a method of controlling heavy fuel oil viscosity, and reference specifications and diagrams of installations are presented.

No. 2546. OIL BURNING: Petroleum Heat & Power Co., 110 Davenport St., Stamford, Conn. 28 p. booklet giving a partial list of "Petro" industrial and commercial oil burning installations, including office buildings; churches, rectories and convents; schools, colleges and universities; factories, warehouses and commercial buildings; hotels; apartments; public buildings; banks; hospitals and sanitariums; theaters; department stores; clubs; laundries; institutional homes; garages and service stations; bakeries and restaurants; and greenhouses and market gardens.

No. 2547. PIPE AND SHEETS: Youngstown Sheet and Tube Co., 602 Stambaugh Bldg., Youngstown, Ohio. 115 p. pocket-size book bound in leatherette cover telling the story of steel from iron ore mine to finished products, illustrated with 135 action photographs. The first section covers the story of steel from iron ore mine to the pouring of ingots and the cutting of billets. Thirteen other sections illustrate the manufacture of flat rolled steel, flat rolled steel in lighter gauges, tin plate,

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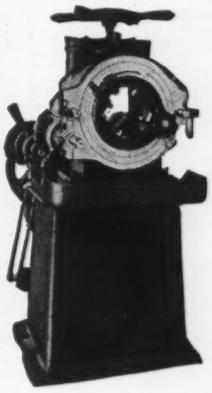

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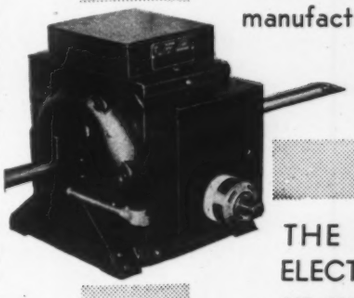

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No. 2548. PIPE AND FITTINGS TOOLS: Billings & Spencer Co., 1 Laurel St., Hartford, Conn. Circular describing forged pipe and fittings tools including reversible chain pipe wrenches, single jaw chain pipe wrenches, the "Gardnerench," and improved chain pipe vises.

No. 2549. PIPE REPAIR CLAMPS: M. B. Skinner Co., South Bend, Ind. 14 p. booklet describing various types of pipe clamps for permanent repair of piping, illustrating the different types. Valve and bibb reseaters are also illustrated.

No. 2550. PRESSURE GOVERNORS: General Electric Co., 1 River Rd., Schenectady, N. Y. Data sheet describing pressure governors recommended by the maker for use with automatic starters for alternating current and direct current motor driven pumps or compressors to maintain a constant pressure between set limits on liquid or gas systems.

No. 2551. PYROMETERS: Brown Instrument Co., Division of Minneapolis-Honeywell Regulator Co., 4534 Wayne Ave., Philadelphia, Pa. 48 p. profusely illustrated book on pyrometers (potentiometer and millivoltmeter types) for indicating, recording and controlling. Detailed information is given on the features of the instruments and the various types available, as well as accessory equipment.

No. 2552. REFRIGERATION: Frick Co., Waynesboro, Pa. Bulletin illustrating and describing installations of this company's refrigeration equipment in Philadelphia and vicinity, including typical air conditioning jobs.

No. 2553. SHADED POLE MOTORS: General Electric Co., 1 River Rd., Schenectady, N. Y. 4 p. bulletin on shaded pole motors, 3.5, 5, and 12 watts, describing applications—including unit heaters, ventilators, humidifiers, and forced draft blowers—and illustrating construction.

No. 2554. SWITCHING DEVICES: General Electric Vapor Lamp Co., Hoboken, N. J. 12 p. catalog on "Kon-nec-tor" mercury switches illustrating and describing twelve common types of mercury-to-mercury and mercury-to-metal switches. A 4 p. section is devoted to applications of this equipment, and capacity and electrical specifications are given.

No. 2555. TANK HEADS AND ACCESSORIES: Commercial Shearing and Stamping Co., Youngstown, Ohio. 28 p. catalog featuring this company's line of tank heads, tank accessories, boiler heads, and stampings, with illustrations, tables of standard sizes and information on construction.

No. 2556. THERMAL PLIERS: Ideal Commutator Dresser Co., 1096 Park Ave., Sycamore, Ill. Folder describing "Thermo" electrical soldering and heating pliers to eliminate open flame soldering and heating work, and for use in soldering or unsweating copper pipe joints, making electrical connections, etc. Among other items described are washer punches and various electrical tools.

No. 2557. THERMOSTATIC CONTROLS: Spencer Thermostat Co., 34 Forest St., Attleboro, Mass. 48 p. catalog showing full line of "Klixon" thermostatic controls including electric and gas actuated controls for heating appliances, room thermostats, limit controls, stoker timers, thermostatic electric switches, thermal relays, and pressure relief valves for hot water supply systems. The unique feature of these controls is the inherent snap-acting operation.

No. 2558. UNDERGROUND STEAM CONDUIT: RicwiL Co., 1562 Union Trust Bldg., Cleveland, Ohio. 4 p. bulletin on underground steam conduit briefly describing its features, illustrating the various types, and showing some recent installations.

No. 2559. UNIT HEATERS: Airtherm Mfg. Co., 1474 S. Vandeventer St., St. Louis, Mo. Bulletin describing method of preventing accumulation of high temperatures under the roofs of factories heated with unit heaters.

No. 2560. UNIT HEATERS: McQuay, Inc., 1600 Broadway, N.E., Minneapolis, Minn. 8 p. bulletin and supplementary price list on copper element unit heaters giving general data, describing construction in detail and presenting capacity and conversion tables and a table of dimensions.

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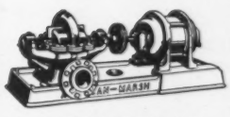

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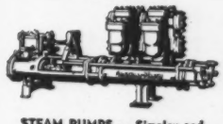

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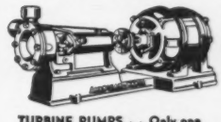

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But now we also build centrifugal pumps, turbine pumps and power pumps for many services.

And so to better associate our Company name with our long established trade name — American-Marsh — by which most of our equipment is known, we have recently changed our Company name to that used in the signature below.

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Centrifugal, Turbine, Steam, and Power Pumps
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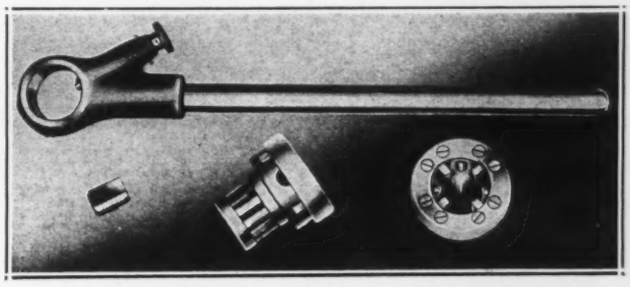

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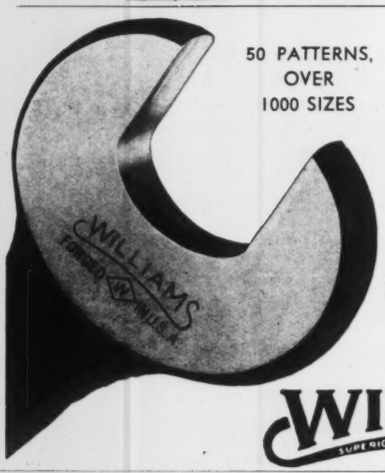

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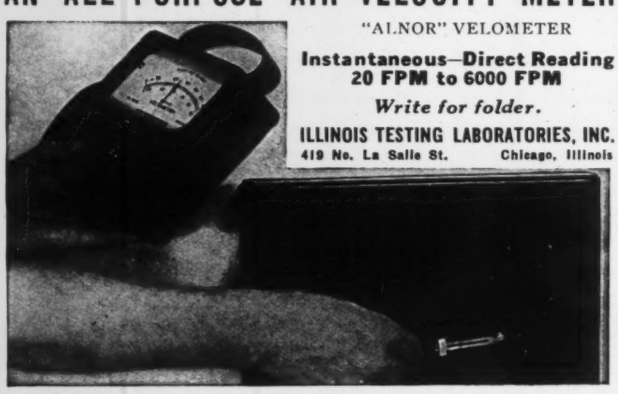

No. 2561. VENTING SYSTEM: Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich. 8 p. technical bulletin on the "Ideal Fast-Venting" system for new and old steam heating systems describing the "Multiport" for radiators, and the "Hurivent" for mains. A discussion of the requirements and how this method meets these requirements is presented and information on construction and operation is given.

No. 2562. VIBRATION: Korfund Co., Inc., 48-15 32nd Pl., Long Island City, N. Y. 16 p. booklet on eliminating vibration losses and describing this company's anti-vibration products, among which are steel spring "Vibro-Dampers," organic material isolators, cork plates, etc. Brief descriptions of typical installations are given, including one pertaining to air conditioning and refrigeration.

No. 2563. WATER HEATERS: American District Steam Co., North Tonawanda, N. Y. 6 p. bulletin on "Adsco" water heaters for industrial and institutional installations including a type for gravity recirculation, submerged heater and condensate cooling service, and a type for maintaining suitable water temperatures to prevent water freezing in elevated tanks. Construction is described and installation diagrams and dimensional capacity tables given.

No. 2564. WELDED PIPING: The Linde Air Products Co., 30 E. 42nd St., New York, N. Y. 12 p. booklet on welded piping, describing new developments in welding building and industrial piping, and how they simplify design problems and lower costs. Among the subjects treated are pipe and services to be welded, use of lighter than standard weight pipe, economical welding methods, layout, drawings and specifications, joints and fittings, shop and field fabrication, and piping erection.

No. 2565. WELDERS AND ELECTRODES: Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. 4 p. bulletin describing small alternating current welders and electrodes, and 4 p. bulletin on electrodes for a-c welding.

No. 2566. WROUGHT IRON TANK CONSTRUCTION: A. M. Byers Co., Clark Bldg., Pittsburgh, Pa. 32 p. technical bulletin on wrought iron for tank construction to supply the demand for information on this subject following the reintroduction six years ago of equipment fabricated from wrought iron plate and sheets after an absence from the market of about thirty years. The suitability of wrought iron for this service is discussed in some detail and numerous illustrations of applications with data on their performance are included.

No. 2567. ZONE HEATING: Webster Tallmadge & Co., Inc., East Orange, N. J. 4 p. bulletin on "Equatherm" and "Airotherm" types of zoned control heating systems (electrically modulated continuous flow). Importance of zoned heating distribution and the matter of thermostatic and automatic electric modulation of steam heating are discussed and information is given on the equipment.

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Please ask the manufacturer to send me more information about the equipment mentioned under the following reference numbers in "Equipment Developments" and "Recent Trade Literature." (Circle the numbers in which you are interested):

1308	1309	1310	1311	1312	1313	1314
1315	1316	1317	1318	1319	1320	1321
1322	1323	1324	1325	1326	1327	1328
1329	1330	1331				
2527	2528	2529	2530	2531	2532	2533
2534	2535	2536	2537	2538	2539	2540
2541	2542	2543	2544	2545	2546	2547
2548	2549	2550	2551	2552	2553	2554
2555	2556	2557	2558	2559	2560	2561
2562	2563	2564	2565	2566	2567	

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